

3529

A REVISION OF PECTIS SECTION PECTOTHRIX (COMPOSITAE: TAGETEAE)

DAVID J. KEIL

Pectis L. sect. *Pectothrix* A. Gray (Compositae: Tageteae) comprises a group of showy, yellow-headed species which occurs mainly in the arid and semi-arid portions of the southwestern United States and northern Mexico. Although several regional floras have included one or more of the species in this group, no workers since Fernald (1897) and Rydberg (1916) have attempted to treat this portion of the genus in its entirety. Since 1916, several workers have described new taxa (Cory, 1937; Johnston, 1940; Wiggins, 1951; Keil, 1974), and many new collections have been made. Recent studies (Keil, 1974) have suggested that the species relationships proposed by earlier workers (Fernald, 1897; Gray, 1884; Rydberg, 1916) should be re-examined.

TAXONOMIC HISTORY

The species included in the present report belong to a complex treated in the past as two subgenera, *Pectidopsis* and *Pectothrix* (Fernald, 1897). *Pectidopsis*, originally described as a monotypic genus (DeCandolle, 1836), was reduced in rank to a section of *Pectis* by Gray (1852), and was subsequently merged with sect. *Eupectis* by Gray (1884). Fernald (1897) resurrected *Pectidopsis* as a subgenus and included within it twelve species with the pappus coroniform and few-bristled or few-awned. *Pectothrix*, described by Gray (1849) as a subgenus of *Pectis*, was reduced to sectional rank three years later (Gray, 1852), but was returned to subgeneric level in Fernald's (1897) revision. Throughout its history, *Pectothrix* has been used for species with a multisetose pappus. Although Rydberg (1916), the last worker to revise this part of *Pectis*, did not accept any infrageneric categories, in most cases he retained the arrangement of species that Fernald had proposed.

RE-EVALUATION OF INFRAGENERIC BOUNDARIES

Previous investigators have emphasized in varying degrees the features of the pappus as characters for subdividing *Pectis*, first

into segregate genera (Lessing, 1830, 1831; DeCandolle, 1836), and later into sections or subgenera (Gray, 1849, 1852, 1884; Fernald, 1897). Although pappus characters can be used in some cases in conjunction with other features in delineating infrageneric categories in *Pectis* (e.g., sect. *Heteropectis* A. Gray), the use of these features alone, like any other one-character taxonomy, is subject to error. Fernald's *a priori* reliance upon pappus characters in his treatment of subgenera *Pectidopsis* and *Pectothrix* illustrates the problems of such an approach.

After field and herbarium studies of a number of the taxa included by Fernald in subg. *Pectidopsis* and subg. *Pectothrix*, I began to doubt the naturalness of these subgenera. Several lines of evidence led me to this viewpoint. First, the taxa included in subg. *Pectidopsis* sensu Fernald fall into two morphologically dissimilar groups which differ in several features (Table 1).

Table 1.

Morphological groups of *Pectis* subg. *Pectidopsis* sensu Fernald

CHARACTER	GROUP I	GROUP II
position of foliar oil glands	marginal	inframarginal or scattered
apex of immature capitula	rounded or truncate	narrowly conical, acute
number of ray florets	5 or 8	5
number of disc florets	10-40	5-10
pubescence of corollas	glandular-puberulent	glabrous

These two groups of taxa have different geographical and ecological ranges as well, with the taxa of Group I occurring in the arid and semi-arid areas of the southwestern United States and northern Mexico, and the species of Group II occupying a more southern distribution, extending well into the tropics of Mexico

SUBGENUS PECTIDOPSIS

SUBGENUS PECTOTHRIX

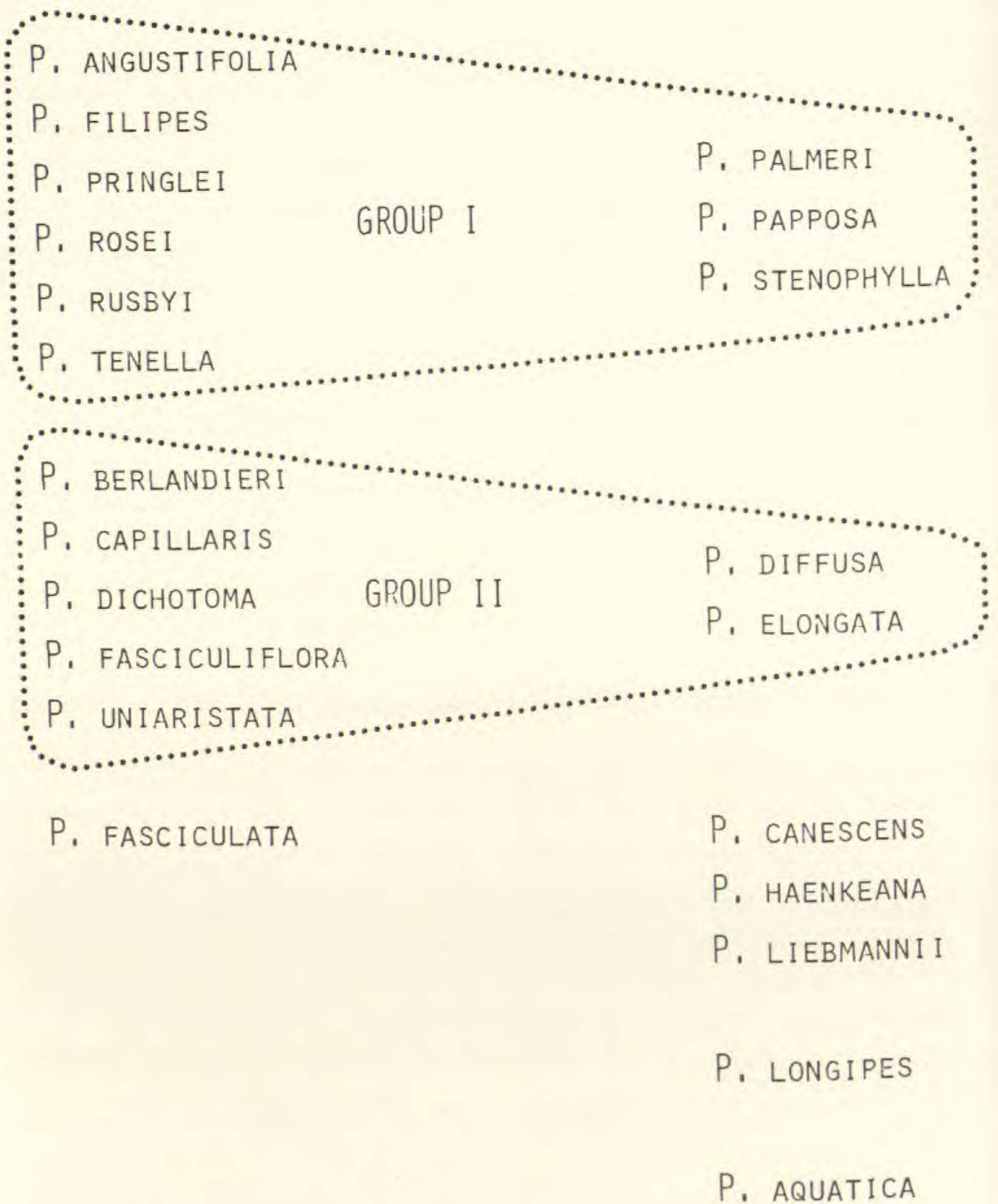


Figure 1. Relationships among species included by Fernald in *Pectis* subgenera *Pectidopsis* and *Pectothrix*.

and Central America. Second, if Fernald's taxonomy is followed, each of these groups of species has a counterpart in his subg. *Pectothrix*. Thus some species of subg. *Pectidopsis* appear to be more closely related to some species of subg. *Pectothrix* than they do to other species of their own subgenus (Figure 1).

The morphological similarity between taxa of different subgenera reflects the biological proximity of these species. Among the species of Group I (Figure 1), several cases of interspecific hybridization involving taxa from both subgenera have been observed (e.g., *Pectis papposa* × *P. angustifolia*, *P. papposa* × *P. filipes*). The hybrids are generally rather vigorous and fertile and evidence of backcrossing to the parent species has been found. This hybridization is an indication of the close relationship of the parent taxa. In one case, taxa of Fernald's different subgenera have even proved to be conspecific (*P. palmeri* of subg. *Pectothrix* is the same as *P. rusbyi* of subg. *Pectidopsis*).

A final line of evidence is the variability of the pappus itself. In some species (e.g., *Pectis angustifolia*, *P. papposa*, *P. rusbyi*), the pappus is sometimes so variable at the population level that the reliability of even infraspecific classifications, which rely on pappus structure, are doubtful.

Based upon this evidence, I have redrawn the infrageneric boundaries to reflect more accurately the species relationships. I have chosen to designate the newly defined infrageneric taxon for which the species of Group I (Figure 1) form a nucleus, as a section rather than as a subgenus. In rejecting the subgenus in favor of the section, I am following the lead of Gray (1884) who wrote concerning *Pectis*: "The genus is very natural; and, although two or three genera have been made from it, it seems incapable of division even into well-marked subgenera." In my opinion, the degree of differentiation among the species of *Pectis* is not sufficient to justify the recognition of subgenera.

The name, *Pectidopsis*, cannot be used for the newly defined section, because the provisions of Article 21 of the *International Code of Botanical Nomenclature* (Stafleu, 1972) prohibit its use at either the sectional or subgeneric level within *Pectis*. However, one of the two original species of sect. *Pectothrix* (for which no type species was ever designated), *P. papposa*, is now included in the section as I have defined it. I have designated *P. papposa* as the lectotype species of sect. *Pectothrix*, which is thus adopted as the name for the newly defined section. To the species of Group I (Figure 1), I have added several taxa described since Fernald (1897) published his revision. This group of taxa constitutes sect. *Pectothrix* as I am treating it.

The taxa which are included in Group II (Figure 1) constitute a distinct section not at all closely related to the species of the redefined sect. *Pectothrix*. This section, for which no name is known to be available, will be the subject of a future report. The remaining species which were included in subg. *Pectothrix* by Fernald are excluded from the present treatment. One of these, *Pectis aquatica*, is better treated as a member of a different genus, *Hydropectis*. The remaining species will be the subject of further investigations. *Pectis fasciculata*, the remaining species in subg. *Pectidopsis*, is a doubtful species of uncertain affinity for which I have been unable to locate a type. Unless or until a type is located for this species, I will exclude it from further consideration.

TAXONOMIC TREATMENT

Pectis L. sect. **Pectothrix** (A. Gray) A. Gray, Smithsonian Contr. Know. 3: 83. 1852. LECTOTYPE SPECIES (here designated):
Pectis papposa Harv. & Gray in A. Gray.

Pectis subg. *Pectothrix* A. Gray, Mem. Am. Acad. 4: 62. 1849.

Helioreos Raf., Atlantic Jour. 1: 145. 1832. TYPE SPECIES: *Pectis angustifolia* Torrey.

Pectidopsis DC., Prodr. 5: 98. 1836, nom. illeg. (superfluous when published).

Pectis sect. *Pectidopsis* (DC.) A. Gray, Smithsonian Contr. Knowl. 3: 83. 1852. nom. illeg.

Pectis subg. *Pectidopsis* (DC.) Fern., Proc. Am. Acad. 33: 72. 1897, nom. illeg.

Glabrous or pubescent annual or perennial usually strong-scented herbs. Stems erect to prostrate, one to many from the base, much-branched above. Leaves linear to elliptic or oblanceolate (pinnatifid in one species), ciliate toward the base with one-several pairs of bristles, punctate with conspicuous marginal oil glands or, in some 8-rayed species, with inframarginal glands on the undersurface. Heads in open to condensed cymose clusters, sessile or on peduncles up to 13 cm long. Immature heads mostly truncate or broadly rounded. Phyllaries usually either 5 or 8, linear to narrowly obovate, obtuse to acutish, strongly carinate, narrowly to broadly hyaline-margined, variously punctate, not or scarcely imbricate, falling individually at maturity. Ray florets 5 or 8; corollas spreading, showy, bright yellow, usually glandular-puberulent below. Disc florets (5-) 10-60; corollas bright yellow, 5-toothed, regular or somewhat bilabiate, usually glandular-puberulent below. Achenes cylindrical, many-ribbed, variously

pubescent, black. Pappus coroniform and/or setose or aristate, the ray pappus often differing from the disc pappus. Chromosome base number: $x = 12$.

DISTRIBUTION: California and Nebraska south to the Mexican states of Sinaloa, Aguascalientes, and San Luis Potosí; one species disjunct in Peru. Locally abundant throughout much of the arid and semi-arid portion of North America from sea level to 2000 m.

KEY TO THE TAXA OF PECTIS SECTION PECTOTHRIX

1. Phyllaries and rays 8 (rarely 7, 9 or 10). 2.
2. Leaves pinnatifid. 7. *P. incisifolia*.
2. Leaves entire or nearly so. 3.
3. Inflorescence rather congested; peduncles mostly less than 15 mm long. 4.
4. Pappus bristles (if present) sub-plumose; trichomes on achenes with curled bulbous tips; leaf bases not flared. 5.
5. Phyllaries 3–5 mm long; disc florets 6–14; disc pappus 1.5–2.5 mm long. 4a. *P. papposa* var. *papposa*.
5. Phyllaries 5–8 mm long; disc florets 12–24 (–34); disc pappus 2.5–4 mm long. 4b. *P. papposa* var. *grandis*.
4. Pappus bristles (if present) short scabrid; trichomes on achenes with straight, bifurcate tips. 6.
6. Bases of upper leaves conspicuously flared, often partially concealing the peduncles; pappus usually only coroniform (weakly aristate or few-setose in some Texan or Chihuahuan populations); plants usually lemon-scented when fresh. 5a. *P. angustifolia* var. *angustifolia*.
6. Bases of upper leaves seldom flared; pappus mostly 1–7 aristate or setose (though sometimes reduced to a low crown); plants usually spicy-scented. 7.
7. Phyllaries broadest near the middle, with a subterminal oil gland less than 0.5 mm long; pappus bristles often exceeding 1 mm; plants always annual; widespread in south Texas and Mexico. 5b. *P. angustifolia* var. *tenella*.
7. Phyllaries broadest near the apex, with a subterminal oil gland 0.5–1 mm long; pappus usually less than 1 mm long; plants annual or perennial; endemic to the Edwards Plateau area of central Texas. 5c. *P. angustifolia* var. *fastigiata*.
3. Inflorescence open; peduncles more than 15 mm long. 8.
8. Phyllaries broadly obtuse, usually conspicuously longitudinally striate; disc pappus of about 20 bristles or rarely reduced to a crown of short scales; ray pappus biaristate. 2. *P. rusbyi*.

8. Phyllaries either not broadly obtuse or not longitudinally striate. 9.
9. Pappus of disc achenes 1-4 aristate, the awns slender, 2-4 mm long; achenes 3-4.5 mm long. 6. *P. pringlei*.
9. Pappus either not aristate or achenes shorter. 10.
10. Ray pappus coroniform or multisetose. 11.
11. Ray pappus coroniform. 12.
12. Disc pappus usually setose; foliar oil glands marginal. 4b. *P. papposa* var. *grandis*.
12. Disc pappus coroniform; foliar oil glands inframarginal on the undersurface. 8a. *P. purpurea* var. *purpurea*.
11. Ray pappus multisetose; plants of Peru. 3. *P. peruviana*.
10. Ray pappus biaristate (sometimes with one or more short scales between the awns). 13.
13. Leaves broadly elliptic or oblanceolate, obtuse, mostly 6-12 mm broad; endemic to coastal areas of southern Sinaloa. 9. *P. sinaloensis*.
13. Leaves linear to narrowly elliptic or oblanceolate, mostly acute to acutish, usually less than 6 mm wide. 14.
14. Ray corollas 7-12 mm long; pappus biseriate. 15.
15. Outer pappus of disc achenes of slender bristles; leaves with 1-3 pairs of marginal cilia; foliar oil glands in submarginal rows. 8b. *P. purpurea* var. *sonorae*.
15. Outer pappus of flattened, fimbriate pales; leaves usually with 4-6 pairs of marginal cilia; foliar oil glands submarginal and scattered on the undersurface. 8c. *P. purpurea* var. *lancifolia*.
14. Ray corollas 2-6 mm long. 16.
16. Plants perennial with a stiff woody caudex. ... 17.
17. Herbage glabrous or nearly so. 1a. *P. stenophylla* var. *stenophylla*.
17. Herbage densely hirtellous. 1b. *P. stenophylla* var. *gentryi*.
16. Plants annual without a woody caudex. 18.
18. Heads mostly broadly campanulate, 17-26 flowered. 1e. *P. stenophylla* var. *biaristata*.
18. Heads narrowly campanulate to cylindrical, 8-17 flowered. 19.
19. Herbage glabrous; leaves very narrow, mostly less than 1 mm wide. 1c. *P. stenophylla* var. *rosei*.
19. Herbage densely hirtellous; leaves often more than 2 mm wide. 1d. *P. stenophylla* var. *puberula*.

1. Ray florets 5 (rarely 4 or 6). 20.
 20. Phyllaries 3.5–6 mm long; disc corollas 2.5–4 mm long; pappus 0–3 aristate.
 21.
 21. Fascicles of small leaves usually present in the upper leaf axils;
 peduncles mostly 10–25 mm long; disc florets 2–8; plants of central and
 southern Sonora. 10a. *P. filipes* var. *filipes*.
 21. Fascicles of leaves usually absent; peduncles mostly 20–50 mm long;
 disc florets 7–22; plants with more northern or eastern distribution. . . .
 10b. *P. filipes* var. *subnuda*.
 20. Phyllaries 6–8 mm long; disc corollas 4–5 mm long; pappus 2–6 aristate;
 plants of Baja California. 11. *P. vollmeri*.

1. ***Pectis stenophylla*** A. Gray, Proc. Am. Acad. **21**: 393. 1886.
 TYPE: Mexico. CHIHUAHUA: near Batopilas, *Palmer 81* (Holo-
 type, GH!; isotypes, K!, PH!). Figure 2.

Annual or perennial herbs from a slender taproot or woody caudex. Stems 10–30 cm long, one to many from the base, erect or decumbent, glabrous to densely hirtellous, ciliate with 1–3 pairs of basal bristles 1–3 mm long, punctate marginally with golden-brown oil glands or, in some forms, punctate submarginally on the undersurface with tiny black glands 0.1–0.2 mm diameter. Peduncles filiform, 2.5–7 cm long, glabrous or hirtellous; bracteoles 3–8, linear to lanceolate, glabrous or hirtellous, sometimes punctate. Heads terminal or axillary; involucre campanulate. Phyllaries linear to oblong, 3.5–5.5 mm long, 0.5–2 mm broad, obtuse to acutish, basally rounded and gibbous, slender-keeled nearly to the apex, glabrous to hirtellous, punctate with 1 or 2 subterminal and 2–3 pairs of slender submarginal glands, these either brown and swollen or tiny and black. Ray florets 8; corollas 2–6 mm long, yellow or becoming tinged reddish, with ligules glabrous and tubes glandular-puberulent. Disc florets 8–26, bilabiate, 1.7–3 mm long, glandular-puberulent. Achenes 1–2.5 mm long, strigillose. Pappus of the ray achenes biaristate, 1–2 mm long; pappus of the disc achenes variable, setose, aristate, and/or coroniform, 1–2 mm long. Chromosome number (from var. *biaristata* only): $n = 12$.

DISTRIBUTION: Eastern Sonora and southwestern Chihuahua to central Sinaloa and western Durango, from 300 to 1500 meters elevation. Very local in thorn forest and oak forest zones (Figure 3).

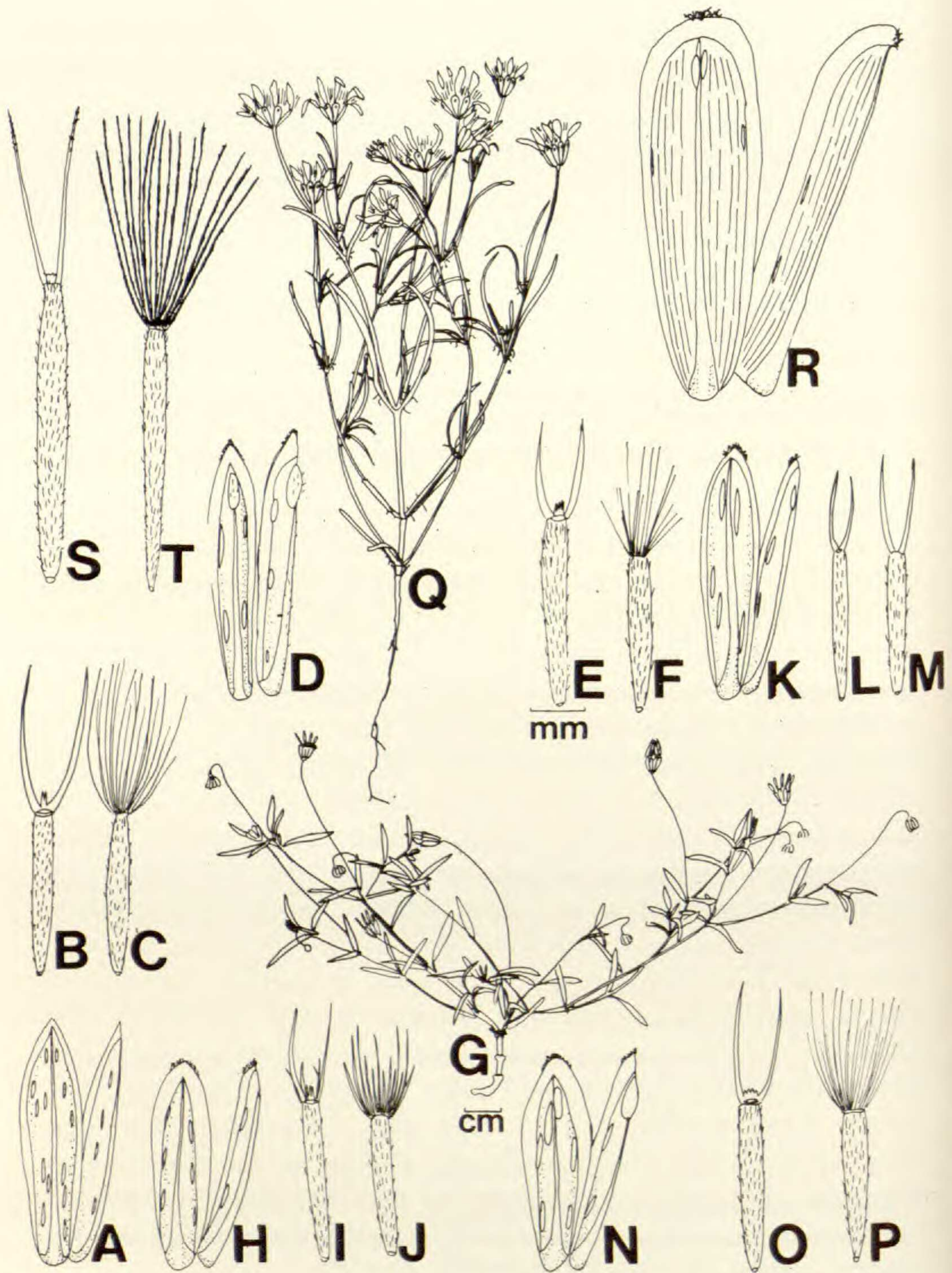


Figure 2. A-P, *Pectis stenophylla*: A-C, var. *biaristata* (Keil & Canne 8752, os); D-F, var. *gentryi* (Gentry 7323, MICH); G-J, var. *puberula* (Gentry 5495, NY); K-M, var. *rosei* (Palmer 730, GH); N-P, var. *stenophylla* (Kimnach & Brandt 950); Q-T, *Pectis rusbyi*. A, D, H, K, N, R, phyllaries; B, E, I, L, O, S, ray achenes; C, F, J, M, P, T, disc achenes; G, Q, habit.

Pectis stenophylla is an unusually variable species. Local races, isolated from other populations, often by considerable distances, have undergone marked divergence. In 1916 Rydberg recognized a total of five species from this complex, a logical treatment based upon the limited samples then available. Each taxon, however, was known from only one or two collections.

In the intervening period since Rydberg's treatment, a number of collections from additional populations have been made. Members of several of these populations have character combinations intermediate to those of species accepted by Rydberg. Because of this observed intermediacy, I have chosen to regard all members of this complex as one polymorphic species and to recognize the variant forms at the varietal level. The species thus defined is comparable to other variable species within sect. *Pectothrix*.

Some objection might be raised to the inclusion of the perennial *Pectis stenophylla*, sensu stricto, in the same species with several annual forms. There is, however, precedent and ample justification for such a treatment. Both perennial and annual forms exist in another species of the section, *P. angustifolia*, and a tendency toward the perennial habit is found in some annual species of other sections (e.g. some populations of *P. prostrata* of sect. *Pectis*). In one population of *P. stenophylla* var. *puberula* (Gentry 5282), annuals and apparently perennial forms occurred together, thus indicating the plasticity of the habit in these plants.

One feature of particular interest in *Pectis stenophylla* is the vestigial nature of the oil glands in some local races. Collectors' notes on herbarium labels indicate that the oils of plants with swollen brown glands are quite aromatic. In some populations, however, the glands are small, dark brown or black, and shrunken, and apparently lack any detectable odor (personal observation). The odorless glands are apparently displaced from the leaf margin during ontogeny. This relationship is quite apparent from an examination of the type collection of *P. scabra*, in which plants with either one or the other type of oil glands coexisted in the same population. Those foliar oil glands that are tiny and black are inframarginal on the undersurface of the leaves. Because this variation can occur within a population, I consider the taxonomic significance of this character to be of minor importance in *P. stenophylla*.

- 1a. ***Pectis stenophylla*** A. Gray, Proc. Am. Acad. **21**: 393. 1886.
var. ***stenophylla***. Figure 2.

Plants perennial. Stems 15–25 cm long, woody and rigid at the base, glabrous or nearly so. Leaves linear, 1–3 cm long, 1–2 mm wide, glabrous, marginally punctate with golden-brown oil glands. Peduncles 2.5–5 cm long, glabrous. Phyllaries 4–4.5 mm long, 1 mm wide, punctate with a conspicuously enlarged subterminal oil gland and smaller submarginal glands. Ray corollas 4–6 mm long. Pappus of the rays 1.5–2 mm long; pappus of the disc 10–20 setose, 1–2 mm long. Chromosome number unknown. Flowering August to April.

DISTRIBUTION: Eastern Sonora and southwestern Chihuahua at 600 to 1500 meters elevation (Figure 3).

In some areas the local residents boil the herbage of *Pectis stenophylla* and use the decoction as a medicine (Gentry, 1942). Since the plants of var. *stenophylla* are not very common (as evidenced by the paucity of collections), such usage, if very common, must put a considerable strain on the populations of this taxon. In species with large population systems, local harvesting is probably of little overall significance. For a taxon as uncommon as var. *stenophylla*, however, man's influence may have profound effects.

REPRESENTATIVE SPECIMENS²: **México**. CHIHUAHUA: Río Batopilas, *Kimnach & Brandt 950* (US); Guagueybo, *Pennington 42* (TEX). SONORA: San Bernardo, *Gentry 1025* (F, GH, MO); San Bernardo, *Gentry 1358* (MICH); Arroyo Hondo, *Hartman 216 p. p.* (GH); Bacadehuachi, *Lloyd 402* (GH).

- 1b. ***Pectis stenophylla*** A. Gray var. ***gentryi*** Keil, var. nov.
Figure 2.

TYPE: **Mexico**. SINALOA: Varomena and vicinity, *Gentry 7325* (Holotype, GH!; isotypes, F!, MICH!, NY!).

Plantae perennes. Caules 15–30 cm longi, basi lignosi rigidesque, dense hirtelli. Folia linearia vel anguste elliptica, 1–2 cm

²Unless a taxon is known from very few collections, only widely distributed or otherwise important specimens are cited. The following abbreviations are used for the collectors of specimens prepared during the present study: *K* = Keil, *K & M* = Keil & McGill, and *K & C* = Keil & Canne. Because duplicates of some of the collections made during the preparation of this study are still being distributed, only the herbarium of the Ohio State University (os) is listed for those collections.

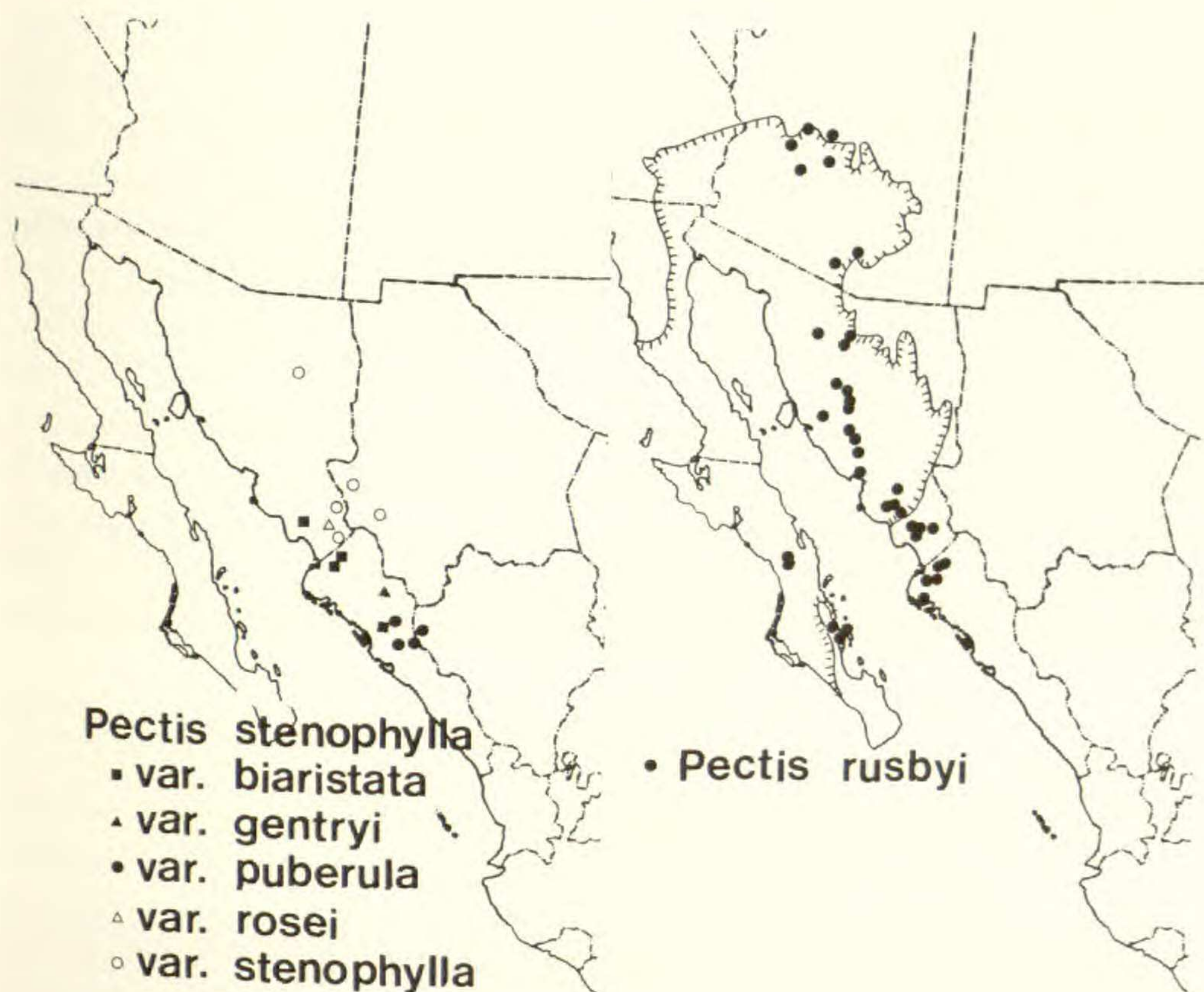


Figure 3. Geographical distribution of *Pectis stenophylla* and *P. rusbyi*. Half-barred line indicates Sonoran Desert boundary (redrawn from Shreve, 1942).

longa, 1–3 mm lata, dense hirtella, margine punctata. Pedunculi 3–5 cm longi, hirtelli vel glabrescentes, 3–5 bracteolati. Phyllaria 4–4.5 mm longa, dense hirtella. Corollae flosculorum radiorum 4 mm longae. Flosculi disci 8–10, corollis 2.5–2.7 mm longis. Achenia 2.5 mm longa. Pappus radiorum biaristatus, 1.5 mm longus; pappus discorum circa 20–setosus, 1–2 mm longus. Chromosomatum numerus ignotus.

DISTRIBUTION: Known only from the type locality in northern Sinaloa at 300 meters elevation (Figure 3).

Gentry's collection is from the Sierra Surotato, a mountain mass isolated from the main cordillera of the Sierra Madre Occidental by a distance of about 40 miles (Gentry, 1946). This plant differs from the more northern var. *stenophylla* in being densely scaberulous rather than almost completely glabrous. In addition, the leaves appear to be mostly shorter and thicker in var. *gentryi* than in var. *stenophylla*.

- 1c. ***Pectis stenophylla*** A. Gray var. ***rosei*** (Fern.) Keil, comb. nov. BASIONYM: *Pectis rosei* Fern., Proc. Am. Acad. 33: 77. 1897. TYPE: **Mexico**. SONORA: Alamos, *Palmer 730* (Holotype, GH!; isotype, US!; photo of US isotype, NY!).

Figure 2

Plants annual. Stems 20–30 cm long, glabrous. Leaves linear, 2–3 cm long, 1 mm wide, strongly revolute, glabrous, punctate on the undersurface with tiny black glands. Peduncles 3–5 cm long, glabrous. Heads cylindrical. Phyllaries very narrowly linear, 3.5–4 mm long, ca 0.5 mm broad, punctate with linear red-black glands. Ray corollas 3 mm long. Disc florets 11–12; corollas 2 mm long. Achenes 2 mm long. Pappus of the rays 1–1.5 mm long; pappus of the disc 2–3 aristate, ca 1.5 mm long. Chromosome number unknown.

DISTRIBUTION: Known only from the type locality in southern Sonora at ca. 1500 meters elevation (Figure 3).

Pectis stenophylla var. *rosei* is perhaps most closely related to var. *stenophylla*, which it resembles in being glabrous and in having very narrow leaves. The two differ in habit, foliar oil glands, and pappus structure. Since var. *rosei* is still known only from its type collection, the full range of variation remains unknown.

- 1d. ***Pectis stenophylla*** A. Gray var. ***puberula*** (Greenm.) Keil, comb. nov. BASIONYM: *Pectis puberula* Greenm., Proc. Am. Acad. 40: 49. 1904. TYPE: **Mexico**. SINALOA? Lodiago, *Palmer 1605* (Syntypes, GH!, US!; isosyntypes, F!, GH!, NY!; lectotype (here chosen), syntype at GH). Figure 2.

Pectis scabra Brandeg., Zoe 5: 226. 1906. TYPE: **Mexico**. SINALOA: Cofradia, *Brandegee s.n.* (Holotype, UCI; isotypes, GH!, POM!, US!).

Plants annual, or sometimes persisting more than one growing season. Stems 10–30 cm long, sparsely to densely hirtellous. Leaves linear to narrowly elliptic, 1–4 cm long, 1–5 mm wide, densely hirtellous, punctate either marginally with golden-brown glands or on the abaxial surface with tiny black glands. Peduncles 3–6 cm long, glabrous to puberulent, 3–6 bracteolate. Heads cylindrical to narrowly campanulate. Phyllaries 3–4.5 mm long, glabrous to densely hirtellous, punctate with either brown or black

glands. Ray corollas narrow, 2–3.7 mm long. Disc florets 8–17; corollas 1.7–3 mm long. Achenes 1–2.5 mm long. Pappus of the rays 1–1.5 mm long; pappus of the disc coroniform, 2–4 aristate or 10–20 setose, highly variable, 1–2 mm long. Chromosome number unknown. Flowering October to March.

DISTRIBUTION: Central Sinaloa and western Durango at 200 to 900 meters elevation (Figure 3).

The pappus of var. *puberula* is highly variable. Within populations from both the type locality of *Pectis puberula* (Palmer 1605) and from the type locality of *P. scabra* (Gentry 5495), a full range from coroniform to short aristate to setose pappus forms occurs. *Pectis scabra* and *P. puberula* were described from different pappus forms. Although the exact locality of Lodiago, the type locality of *P. puberula*, has been lost (McVaugh, 1956), and it is not certain whether the site is in eastern Sinaloa or western Durango, there is no doubt that it is only a few miles from Cofradia, Sinaloa, the type locality of *P. scabra*.

REPRESENTATIVE SPECIMENS: **México.** DURANGO: Sierra Tres Picos, Gentry 5282 (ARIZ, DS, F, GH, MO, NY, UC). SINALOA: Las Milpas, Gentry 5361 (DS, GH, MO); Cofradia, Gentry 5495 (ARIZ, DS, F, GH, MICH, MO, NY, UC, US); Badiraguato, Gentry 5781 (ARIZ, DS, GH, MICH, MO, NY).

1e. ***Pectis stenophylla* A. Gray var. *biaristata* (Rydb.) Keil, comb. nov.** BASIONYM: *Pectis biaristata* Rydb., N. Am. Fl. 34: 211. 1916. TYPE: **Mexico.** SINALOA: vicinity of Fuerte, Rose, Standley & Russell 13537 (Holotype, NY!; isotype, UC!). Figure 2.

Plants annual. Stems 5–25 cm long, sparsely to densely hirtellous. Leaves linear to narrowly elliptic, 1–3 cm long, 1–3 mm wide, nearly glabrous to densely hirtellous, punctate marginally with brown oil glands or submarginally on the abaxial surface with black glands. Peduncles 3–5 cm long, glabrous to densely hirtellous. Heads broadly campanulate. Phyllaries linear to oblanceolate, 4–5 mm long, 1–2 mm broad, glabrous or hirtellous, punctate with small dark glands. Ray corollas 4.5–5 mm long. Disc corollas 17–26, ca 3 mm long. Achenes 2.3–2.5 mm long. Pappus of the rays 1.7–1.8 mm long; pappus of the disc 1–3 aristate or 10–20 setose, 1–2 mm long. Chromosome number: $n = 12$. Flowering September to March.

DISTRIBUTION: Southern Sonora (?) to central Sinaloa (Figure 3).

A collection from Sonora (*Sikes & Babcock 178*) is referred with some doubt to var. *biaristata*. It appears to be a mixed collection including some putative hybrids with another undetermined species. The plants resemble var. *biaristata*, but because of the depauperate nature of the specimens, the determination is made with some reservations.

REPRESENTATIVE SPECIMENS: **México**. SINALOA: W of Pericos, *Gentry 5751* (GH, MICH, MO); 16.8 mi SW of El Fuerte, *K & C 8752* (OS).

2. ***Pectis rusbyi*** Greene ex A. Gray, *Syn. Fl. N. Am.* 1(2): 361. 1884. TYPE: **United States**. ARIZONA: Yavapai Co., Beaver Creek, *Rusby 317* (= *s.n.* or 655) (Holotype, GH!; isotypes, F!, K!, MICH!, PH!, RSA!, UC!, US!). Figure 2.

Pectis palmeri S. Wats., *Proc. Am. Acad.* 24: 58. 1889. TYPE: **Mexico**. SONORA: Guaymas, *Palmer 653* (Lectotype (here chosen), GH!).

Pectis mearnsii Rydb., *N. Am. Fl.* 34: 209. 1916. TYPE: **United States**. ARIZONA: Yavapai Co., Fort Verde, *Mearns 184* (Holotype, NY!).

Strong-scented tap-rooted annuals, erect or branching from the base. Stems 5–50 cm long, erect or decumbent, often dichotomously branched, glabrous or sparsely puberulent on the angles. Leaves linear to narrowly elliptic, 1–5 cm long, 1–5 mm broad, often revolute, ciliate with 1–3 pairs of basal bristles 1–2 mm long, otherwise entire, glabrous or glabrescent, marginally punctate with rounded oil glands 0.2–0.7 mm diameter. Peduncles 2–8 cm long, glabrous, with 3–6 lance-attenuate or setiform bracteoles 1–3 mm long. Heads in forks of stems and axillary, becoming crowded in age. Phyllaries 8, oblong or narrowly obovate, 4–7 mm long, 1–2 mm broad, very obtuse to subacute, longitudinally striate with 3–5 usually conspicuous nerves on each side of the conspicuous, corky, basally gibbous midrib, hyaline margined, apically ciliolate, otherwise glabrous, punctate with 0–2 subterminal oil glands and 2–4 pairs of inconspicuous, rounded to narrow-elongated submarginal glands. Ray florets 8; corollas 5–11 mm long, with broadly ovate glabrous ligules and slender, glandular-puberulent tubes. Disc florets (7–) 20–55; corollas 3.5–5 mm long, bilabiate with the narrow lobe ca. twice the length of the teeth on the broad lobe, glandular-puberulent on the tube below. Achenes 3–4.5 mm long, strigillose or pilosulose. Pappus of the ray achenes 0–4 aristate and/or coroniform; awns slender, 1–4 mm

long, antrorsely barbed towards the tips. Pappus of the disc achenes coroniform or 15–30 setose; bristles 2.5–5 mm long, antrorsely barbed. Chromosome number: $n = 12$. Flowering August to February.

DISTRIBUTION: Central Arizona to southern Baja California and northern Sinaloa at elevations of 0–1200 meters (Figure 3).

Pectis rusbyi has a mostly Sonoran Desert distribution, barely extending beyond the desert into the grassland in central Arizona and occurring sporadically in the thorn forest of southern Sonora and northern Sinaloa.

In central Arizona, *Pectis rusbyi* exhibits a striking dimorphism of pappus structure. The type of *P. rusbyi* is essentially epappose, whereas the type specimen of *P. mearnsii*, collected only a few miles from that of *P. rusbyi*, has a setose pappus. However, based upon personal field observations, both pappus forms may coexist in the same population. For example, in both Maricopa and Yavapai Counties of Arizona, some individuals were found with a setose pappus and numerous others with only a coroniform pappus (Keil 8569, 8575). As a result of these observations, I regard both *P. rusbyi* and *P. mearnsii* as conspecific.

Kearney and Peebles (1942) placed *Pectis mearnsii* in synonymy with *P. palmeri*, a decision with which I heartily concur. The two taxa are essentially indistinguishable. However, with the present evidence of the conspecificity of *P. mearnsii* and *P. rusbyi*, *P. palmeri* must necessarily also be treated as a synonym of *P. rusbyi*.

In lowland areas of southern Sonora, a weedy, large-headed race occurs commonly along roadsides and in cultivated areas (Keil & Canne 8632, 8652). On some sites, this form is so common that it becomes an aspect dominant, coloring large areas with its showy yellow heads. In less disturbed sites, this form grades into the smaller-headed forms more typical of the species. Large-headed forms occur throughout much of the range of the species and are not limited to the weedy race. On the basis of the evidence presently available, taxonomic recognition of these forms does not seem justified.

Pectis rusbyi usually can be distinguished from other related species by its broad, apically flattened, longitudinally striate phyllaries. A few populations from Baja California and Sinaloa

(e.g. *Flyr 68*, *Wiggins 15533A*) have smaller, more convex, less conspicuously striate phyllaries. However, in other respects these plants are so similar to other populations of *P. rusbyi* that taxonomic separation even at the varietal level does not seem warranted.

Pectis rusbyi sometimes hybridizes with *P. papposa* var. *papposa* and with *P. filipes* var. *filipes* in Sonora where complex hybrid swarms may develop locally. In Arizona, however, where *P. papposa* var. *papposa* and *P. rusbyi* have been observed to grow together, no hybrids have been found.

REPRESENTATIVE SPECIMENS: **México.** BAJA CALIFORNIA SUR: Purissima, *Brandegees.n.* (GH, US); W of Los Dolores, *Wiggins 15533A* (MICH, TEX). SINALOA: near Topolobampo, *Flyr 69* (TEX, WIS); 1.8 mi E of San Blas, *K & C 8744* (OS). SONORA: Guaymas, *Gentry 4682* (F, GH, MICH, MO, PH, SD, US); 11 mi NW of Cd. Obregon Airport, *K & C 8652* (OS). **United States.** ARIZONA: Maricopa Co.: White Tank Mts., *K 8569*, *8570* (OS); Yavapai Co.: 2.5 mi S of Beaver Creek Ranger Station, *K 8575* (OS).

3. *Pectis peruviana* Keil, sp. nov.

Figure 4.

TYPE: **Peru.** CAJAMARCA: Canyon of the Río Marañon, opposite Balsas, *Hutchison & Wright 5414* (Holotype, UC!; isotypes, F!, US!).

Plantae perennes, graveolentes. Caules usque ad 15 cm longi, solitarii aut basaliter ramosi, super medium ramulosi, rubelli, puberuli. Folia linearia, 1.5–3 cm longa, 1–1.5 mm lata, glabra, in dimidio inferiore setis 2–4 mm longis ciliata, mucronata vel setifera, glandibus oleosis marginalibus 0.2 mm diametro punctata. Capitula terminalia axillariaque. Pedunculi exiles, 2–3 cm longi, bracteolis 4–7, setiferis, 1–2 mm longis, glanduloso-punctatis. Involucra anguste campanulata, phyllariis 8, uniserialibus, linearibus, 6 mm longis, 1 mm latis, acutis, costa gracili, basaliter gibbosa, suberoso-incrassata fere usque ad apicem, tenuimarginatis, ad apices ciliolatis, aliter glabris, glandibus oleosis anguste aut late ellipticis ad apicem et utroque costae dense punctatis. Flosculi radii 8, corollis 6–8 mm longis, citrinis aut rubrescentibus, glabris, ligula 3–5 mm longa 1–1.5 mm lata apice minute tridenticulata. Flosculi disci 10–12, corollis 5 mm longis, citrinis, glabris, paene regularibus, 5-dentatis, dentibus 1.5 mm longis, antheris 1.5 mm longis, basaliter sagittatis, ad apicem appendice minute emarginata. Achenia cylindrica, discorum 3.5–4 mm longa, radiorum 4.5 mm longa, brunnea aut nigra, trichomatibus brevibus badiis

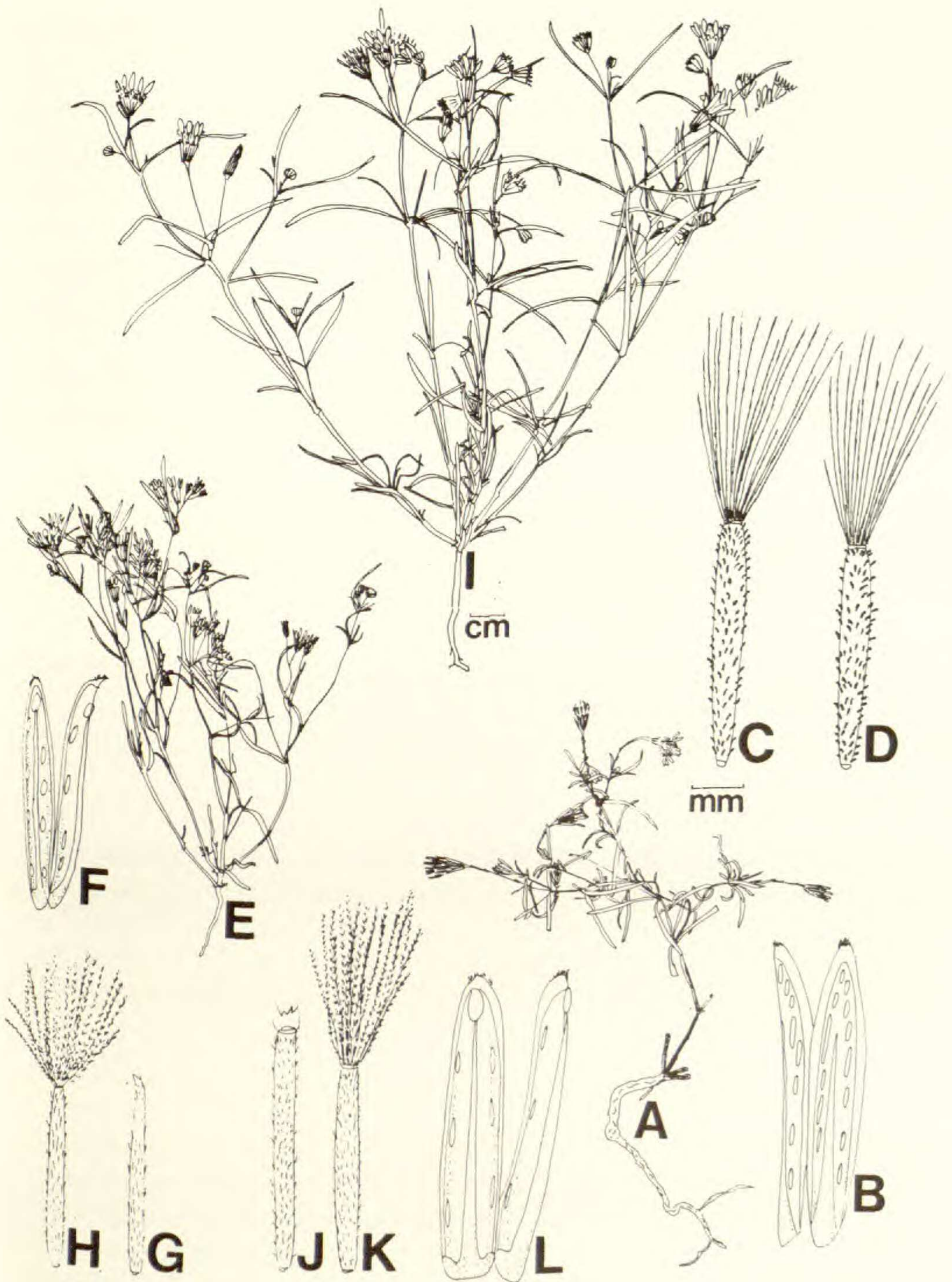


Figure 4. A-D, *Pectis peruviana* (Hutchison & Wright 5414, F); F-L, *Pectis papposa*; E-H, var. *papposa* (Keil & Canne 8758, os); I-L, var. *grandis* (Keil & McGill 7786, os). A, E, I, habit; B, F, L, phyllaries; C, G, J, ray achenes; D, H, K, disc achenes.

clavatis bicellularibus puberulenta. Pappus idem in flosculis radii ac disci, 12–20 setosus, setis 4 mm longis, antrorse scabridis. Chromosomatum numerus ignotus.

DISTRIBUTION: Presently known only from the type collection in northern Peru at an elevation of 1100 meters. *Pectis peruviana* is the only representative of sect. *Pectothrix* known to occur outside of North America. The occurrence of taxa in the North American deserts and also in Peru is not limited in *Pectis*, however, to sect. *Pectothrix*. *Pectis linifolia* L. of sect. *Pectidium* has races in the Sonoran Desert and also in the deserts of Peru. Indeed, Hutchison & Wright collected *P. linifolia* near the type locality of *P. peruviana*.

Pectis peruviana bears an overall resemblance to *P. stenophylla* var. *stenophylla*. Both are perennial taxa with narrowly linear leaves, elongate peduncles and a multisetose disc pappus. However, these taxa differ in several respects. *Pectis stenophylla* generally has smaller flowers, glandular puberulent rather than glabrous corollas, a biaristate rather than multisetose ray pappus and slender rather than clavate trichomes on the achenes.

The evolutionary relationship between *Pectis peruviana* and the remaining species of sect. *Pectothrix* is not certain. The multisetose pappus is apparently a primitive feature in *Pectis* and the aristate types have been derived from it. The perennial habit and multisetose pappus of *P. peruviana* suggest that this is a relatively primitive species in the section. If these assumptions are true, then *P. peruviana* is probably an early offshoot from the section *Pectothrix* progenitor and has been separated from the rest of the section for a considerable period of time. Whatever the length of time that *P. peruviana* has remained in isolation from the rest of the section, it apparently has not enjoyed the evolutionary success that the North American species have displayed.

4. ***Pectis papposa*** Harv. & Gray in A. Gray, Mem. Am. Acad. 4: 62. 1849. TYPE: Mexico. "CALIFORNIA," (probably collected near Hermosillo or Guaymas, Sonora), Coulter 331 (Holotype, TCD!; isotypes, GH!, K, two sheets!). Figure 4.

Pectis papposa Harv. & Gray var. *epapposa* A. Gray, Geol. Surv. Calif. Bot. 1: 617. 1880. TYPE: United States. CALIFORNIA: San Diego Co., Larkens, Palmer 200 p.p. (Holotype, GH!).

Bushy strong-scented annuals. Stems 1–30 cm long, much branched, glabrous or minutely puberulent. Leaves linear, 1–6 cm long, 1–2 mm wide, basally ciliate with 1–3 pairs of bristles 1–2 mm long, otherwise entire, glabrous, marginally punctate with rounded to oval oil glands 0.3–0.5 mm diameter. Peduncles 3–40 mm long, glabrous, with 2–6 hyaline, lanceolate bracteoles ca. 1 mm long. Heads clustered at tips of branches. Involucre cylindrical to campanulate. Phyllaries 8, rarely 7, 9 or 10, linear, 3–8 mm long, 0.5–1.7 mm wide, apically acutish, basally truncate, gibbous, strongly convex-keeled almost to the tips, narrowly hyaline-margined, apically ciliolate, otherwise glabrous, punctate with 1–5 swollen subapical glands and 2–5 pairs of smaller, inconspicuous submarginal glands, occasionally with additional dorsal glands. Ray florets 8, rarely 7, 9, or 10; corollas 3–8 mm long, with narrowly to broadly ovate glabrous ligules and slender glabrous or glandular-puberulent tubes. Disc florets 6–34; corollas 2–5.5 mm long, bilabiate, with the narrow lobe ca. twice the length of the teeth on the broad lobe, glabrous or glandular-puberulent below. Achenes 2–5.5 mm long, strigillose or pilosulose with slender, bulbous-tipped unicellular trichomes. Pappus of ray florets coroniform, ca. 0.2 mm long, rarely 1-several aristate or setose. Disc pappus 16–24 setose, 1.5–4 mm long, or occasionally only coroniform; bristles slender, sub-plumose, spreading. Chromosome number: $n = 12$.

DISTRIBUTION: Southern California and southwestern Utah to western Texas, south to Baja California, Sinaloa, Chihuahua and Coahuila (Figure 5). *Pectis papposa* occurs, often in great abundance, in all four of North America's deserts, occupying a variety of habitats. Under favorable conditions, this species sometimes becomes an aspect dominant, coloring wide areas with its bright yellow heads. *Pectis papposa* is divided into two well-marked geographic varieties. The typical one occurs in the Mojave and Sonoran Deserts, whereas var. *grandis* is restricted mostly to the Chihuahuan Desert.

4a. ***Pectis papposa*** Harv. & Gray in A. Gray, Mem. Am. Acad. 4: 62. 1849. var. ***papposa***. Figure 4.

Stems 1–20 cm long. Leaves 1–3 cm long, 1–2 mm broad. Peduncles 3–10 (–25) mm long, 3–6 bracteolate. Heads densely

clustered at tips of the branches, or in some Mexican forms more diffuse. Phyllaries 3–5 mm long, ca. 0.5 mm broad, punctate with 1–3 subapical glands and 2–3 pairs of submarginal glands. Ray corollas 3–6 mm long, ca. 0.5 mm broad, glabrous or glandular-puberulent. Disc florets 6–14 (–18); corollas 2–3.5 (–4) mm long, glabrous or glandular-puberulent. Achenes 2–4.5 mm long. Pappus of disc achenes setose or sometimes coroniform; bristles 1–2.5 mm long. Chromosome number: $n = 12$. Flowering mostly June to December.

DISTRIBUTION: Southern California and southwestern Utah to southwestern New Mexico, south to Baja California and central Sinaloa at elevations ranging from minus 60 to 1500 meters (Figure 5).

Pectis papposa var. *papposa* often colors large areas of the Sonoran Desert during late summer. It is particularly abundant in central Arizona on the broad inter-mountain alluvial plains and also occurs on the low desert mountain ranges. The plants of var. *papposa* are morphologically variable, and a number of intergrading local races occur within its range. Peduncle length, branching habit, and pappus structure are among the features that vary, but none of these populational differences seems worthy of formal taxonomic recognition.

Bradley and Haagen-Smit (1949) reported that a large portion of the essential oils of *Pectis papposa* (var. *papposa*) is composed of cumin, and they suggested that *P. papposa* might be grown as a commercial crop for this oil. To my knowledge, this suggestion apparently has not been pursued.

REPRESENTATIVE SPECIMENS: **México.** BAJA CALIFORNIA: S of Laguna Seca Chapala, Carter, Alexander & Kellogg 1890 (DS, GH, MO, SD); Los Angeles Bay, Palmer 657 (GH, ND-G, NY, UC, US). BAJA CALIFORNIA SUR: 6 mi S of La Paz, Hammerly 235 (CAS, DS, SD). SINALOA: 1 mi E of Altata, Flyr 113 (TEX, WIS). SONORA: Corral, Gentry 4745 (DS, GH, MICH, MO); near Gulf of California, Pringle s.n. (F, MICH, PH, WIS).

United States. ARIZONA: Mohave Co.: Willow Springs, Demaree 41527 (ASC, ASU, GH, KANU, SMU); Pinal Co.: Maricopa, Pringle, s.n. (F, GH, MO, PH). CALIFORNIA: Riverside Co.: La Quinta, Rose 61063 (CAS, ENCB, TEX); San Bernardino Co.: Needles, Jones 3872 (CAS, DS, F, PH). NEVADA: Clark Co.: Charleston Mts., Clokey 8197 (CAS, DS, F, GH, KSC, MICH, MIL, MO, PH, SD, SMU, TEX, WIS); Lincoln Co.: Timpahute Range, Reveal & Holmgren 1904 (DS, KANU, KSC, MICH, SMU, TEX). NEW MEXICO: Hidalgo Co.: Cienega Lake turnoff on US 80, K & M 8500 (OS). UTAH: Washington Co.: 8.6 mi N of St. George, Gould 1363 (CAS, F, GH, ND, PH, RSA).

- 4b. **Pectis papposa** Harv. & Gray in A. Gray var. **grandis** Keil, *Brittonia* 26: 32. 1974. TYPE: **United States**. TEXAS: Presidio Co., 3 mi E of junct US Rte 67 on Texas Rte 170, E of Presidio, *McGill & Keil 7768* (Holotype, US!; isotypes, ARIZ!, ASU!, ENCB!, F!, GH!, MICH!, MO!, NY!, OS!, RSA!, SMU!, TEX!, UC!). Figure 4.

Stems 5–30 cm long. Leaves 2–6 cm long, 1–2 mm broad. Peduncles 1–4 cm long, 2–6 bracteolate. Heads usually several at tips of branches. Phyllaries 5–8 mm long, 1–1.7 mm broad, punctate with 1–5 subterminal glands and 2–5 pairs of submarginal glands. Ray corollas 5–8 mm long, glabrous or sparsely glandular-puberulent. Disc florets 12–24 (–34); corollas 3–5 mm long, glabrous or glandular-puberulent. Achenes 3–5.5 mm long. Pappus of disc achenes 2.5–4 mm long, setose or rarely short-coroniform. Chromosome number: $n = 12$. Flowering June to October.

DISTRIBUTION: Southern New Mexico and southwestern Texas to Chihuahua and northern Coahuila; disjunct in Arizona and northeastern New Mexico (Figure 5). The distribution of this variety is primarily in the Chihuahuan Desert at elevations of 1000 to 2000 meters. The plants of var. *grandis* are particularly common in the Rio Grande valley in Texas, New Mexico and northern Mexico. This taxon is undoubtedly more common in northern Coahuila than is indicated by presently available collections. The plants grow almost to water's edge along the Rio Grande on the Texas side of the border, but I have seen no collections from the opposite bank.

REPRESENTATIVE SPECIMENS: See Keil (1974) for specimen citations for *Pectis papposa* var. *grandis*.

5. **Pectis angustifolia** Torrey, *Ann. Lyceum Nat. Hist. New York* 2: 214. 1828. TYPE: **United States**. (COLORADO OR NEW MEXICO): "on the Rocky Mountains," 1820, *James s.n.* (Holotype, NY!). Figure 6.

Helioreos angustifolius (Torrey) Raf., *Atlantic Jour.* 1: 145. 1832.

Pectidopsis angustifolia (Torrey) DC., *Prodr.* 5: 98. 1836, nom. illeg.

Pectis angustifolia Torrey var. *subaristata* A. Gray, *Smithsonian Contr. Knowl.* 3: 82. 1852. TYPE: **United States**. TEXAS: "valley between the Pecos and the Limpia," *Wright 244* (Holotype, GH!; isotypes, K!, MO!, NY!, US!).

Pectis papposa Harv. & Gray in A. Gray var. *sessilis* M. E. Jones, *Contr. West. Bot.* 12: 46. 1908. TYPE: **United States**. NEW MEXICO: Socorro Co., Socorro, *Diehl s.n.* (Lectotype (*fide* Blake, 1945), POM!; photo and fragment of lectotype, US!).

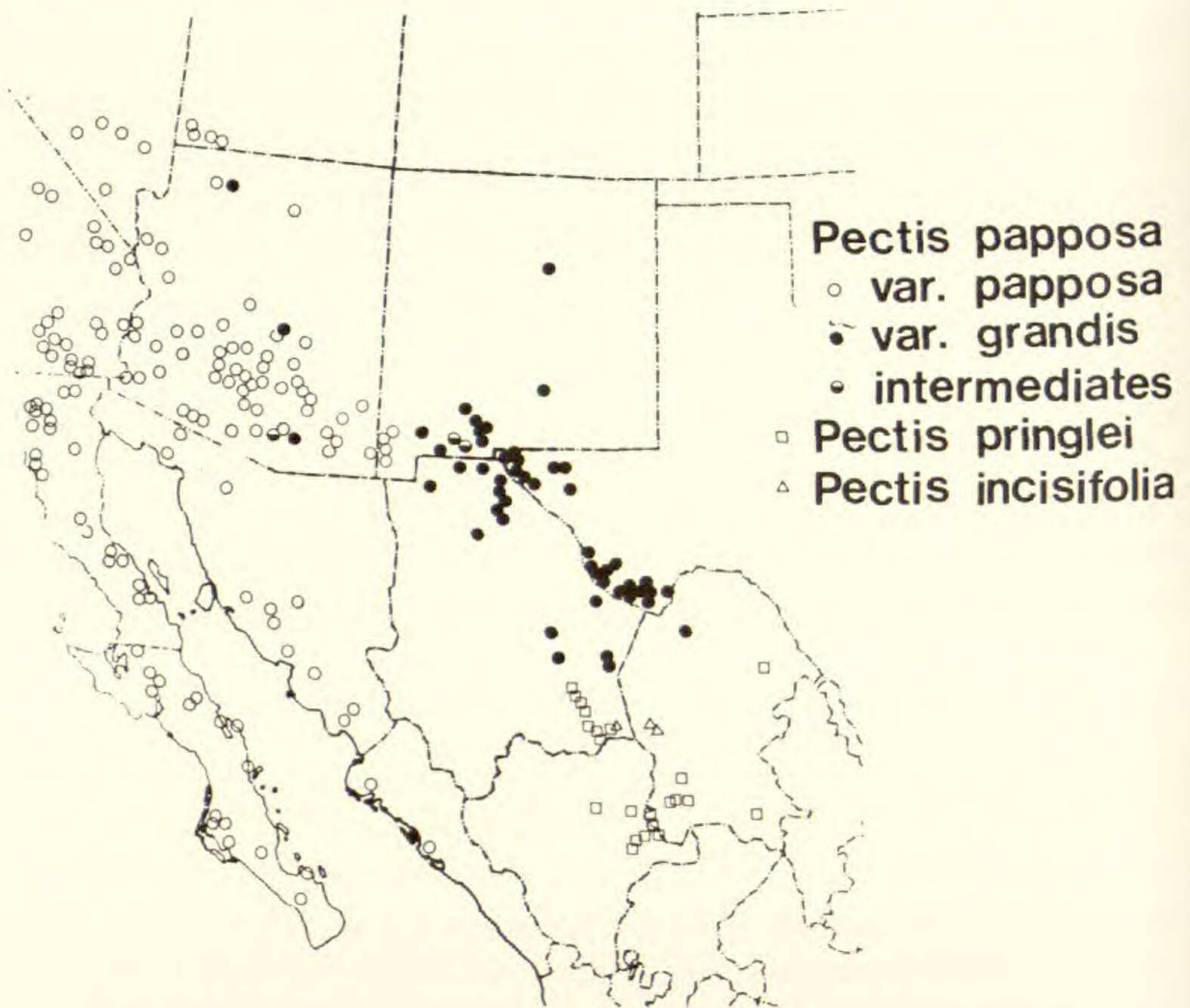


Figure 5. Geographical distribution of *Pectis papposa*, *P. pringlei* and *P. incisifolia*.

Annual or perennial herbs from a slender tap-root or ligneous caudex. Stems 1–20 cm long, usually branched from the base, glabrous or minutely puberulent. Leaves linear, 1–4.5 cm long, 1–3 mm broad, 2–5 ciliate at the base with bristles 1–2 mm long, mucronate, often strongly revolute, glabrous, marginally punctate with glands 0.2–0.7 mm diameter. Peduncles 1–20 mm long, with 2–5 bracteoles 1–3 mm long. Heads congested at ends of branches, narrowly campanulate or cylindrical. Phyllaries linear or narrowly oblanceolate, 2.5–5.5 mm long, obtuse, basally truncate and strongly gibbous, very strongly convex-keeled nearly to the apex, glabrous, punctate subterminally with 1 or 2 swollen oil glands, and submarginally with 2–5 pairs of smaller glands. Ray florets 8; corollas 3–5 (–7) mm long, glandular-puberulent or nearly glabrous. Disc florets (7–) 10–20; corollas 2.5–3.5 mm long, regular or bilabiate, glandular-puberulent. Achenes 2.5–4 mm long, stri-

gilliose with bifurcate trichomes. Pappus variable, coroniform and/or 1-7 aristate or setose, 1-2 mm long. Chromosome number: $n = 12$.

DISTRIBUTION: Wyoming and Nebraska south to Durango, San Luis Potosí and Veracruz (Figure 7).

In the *Pectis angustifolia* complex previous workers (Gray, 1884; Fernald, 1897; Rydberg, 1916) have relied primarily on the features of the pappus as taxonomic characters. Three taxa traditionally have been recognized in the complex on the basis of differences in pappus structure: *Pectis angustifolia*, *P. angustifolia* var. *subaristata* and *P. tenella*. A fourth group of plants has twice been named as a species (*P. fastigiata* Gray, 1849; *P. texana* Cory, 1937) and twice re-united with *P. angustifolia* (Gray, 1852; Correll & Johnston, 1970).

The value of the pappus as a character in this complex has been greatly overemphasized. Although easily distinguishable forms exist in some regions, in other areas there is so much variation in pappus structure that as many as three "taxa" could be recognized from the members of an otherwise homogeneous population. A re-examination of taxonomic boundaries, necessitated by the breakdown of the traditionally accepted scheme, has led me to two conclusions. First, the *Pectis angustifolia* complex should be recognized as a single species with three varieties: *P. angustifolia* var. *angustifolia*, var. *tenella* and var. *fastigiata*. Second, Gray's var. *subaristata* has often been misapplied, and in its strict interpretation, cannot be distinguished from var. *angustifolia*.

5a. ***Pectis angustifolia*** Torrey, Ann. Lyceum Nat. Hist. New York 2: 214. 1828. var. ***angustifolia***. Figure 6.

Bushy lemon-scented annuals. Stems 1-20 cm long, densely leafy at the tips. Leaves 1-4.5 cm long, 1-3 mm wide, conspicuously flared at the bases. Peduncles mostly 1-10 mm long, 1-4 bracteolate, often wholly or partially concealed by the bases of the subtending leaves. Phyllaries 2.5-5.5 mm long, linear, strongly keeled to the tips, abruptly truncate, punctate with 1 or 2 subterminal glands 0.2-0.5 mm long, and smaller submarginal glands. Ray corollas 3-5 mm long. Disc florets (7-) 10-20; corollas 2.5-3.5 mm long, slightly bilabiate. Achenes 2.5-4 mm long.

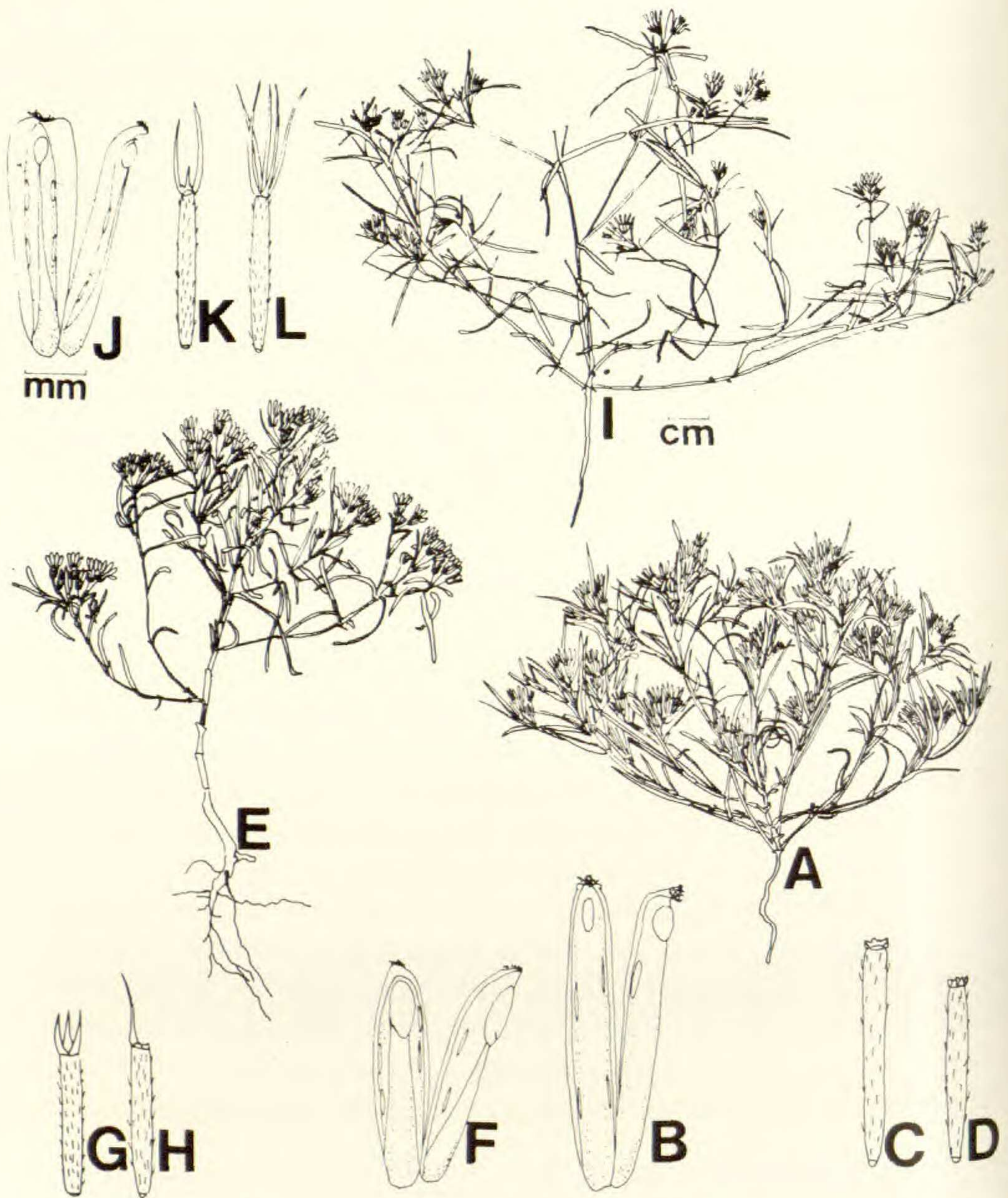


Figure 6. *Pectis angustifolia*; A-D, var. *angustifolia* (Keil 7634, os); E-H, var. *fastigiata* (Tharp & Warnock 45-30, ARIZ); I-L, var. *tenella* (Keil & McGill 7849, os). A, E, I, habit; B, F, J, phyllaries; C, H, K, ray achenes; D, G, L, disc achenes.

Pappus coroniform, 0.1–0.3 mm long, or in some Texas and Chihuahua populations also 1–7 aristate or setose. Chromosome number: $n = 12$. Flowering July to October.

DISTRIBUTION: Western Nebraska to eastern Arizona, western Texas, Chihuahua and northern Durango, grading into var. *tenella* in eastern Chihuahua and Durango (Figure 7).

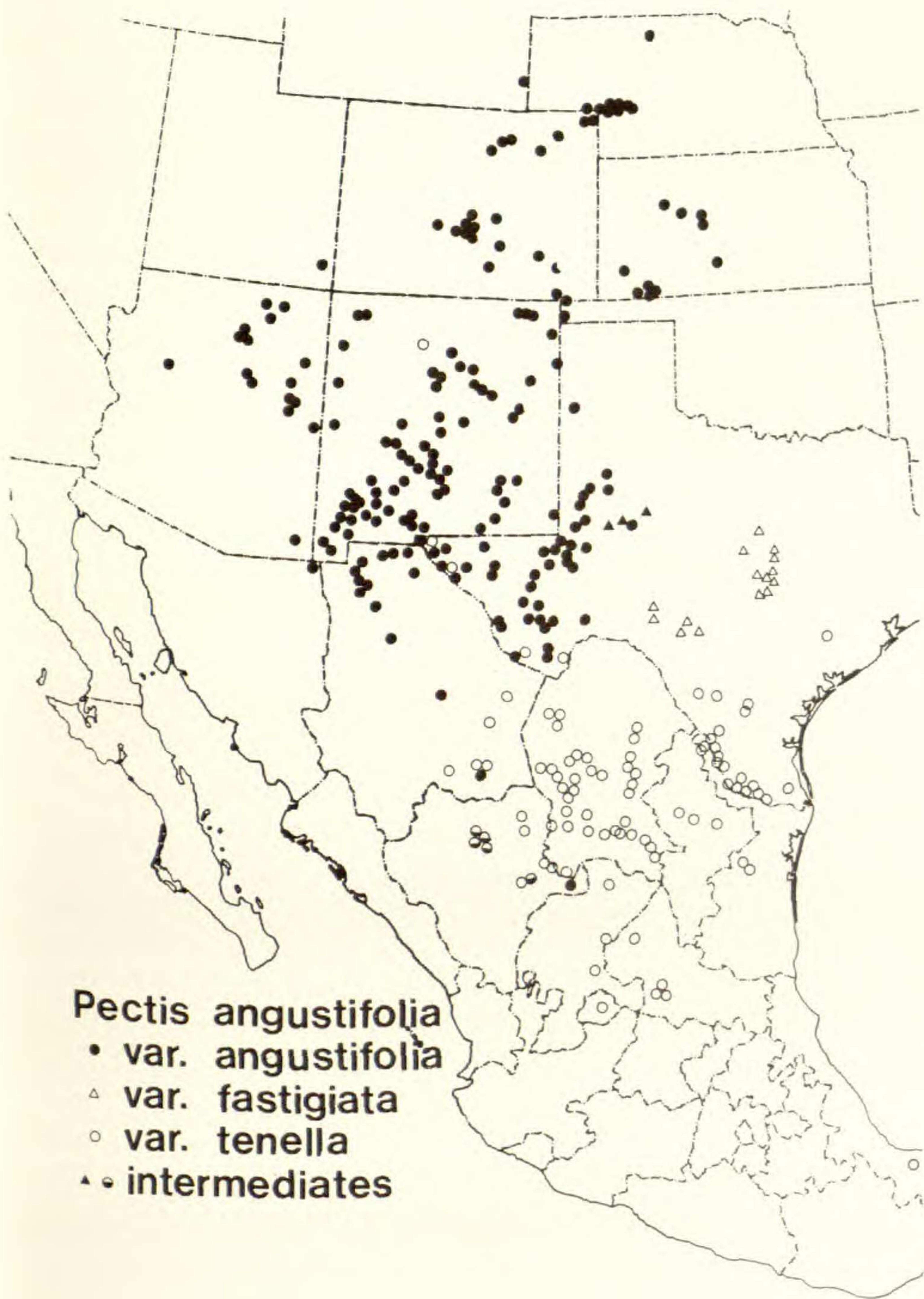


Figure 7. Geographical distribution of *Pectis angustifolia*.

The present interpretation of morpho-geographical variation in the *Pectis angustifolia* complex has necessitated a re-interpretation of var. *subaristata*. This name has been applied widely over the years to any individual with a few-bristled pappus. An examination of the type material of this taxon revealed that, with the exception of the slightly bristly pappus, these plants are not distinguishable from individuals of var. *angustifolia*.

The "subaristate" forms to which this name has been applied are of several different origins. Spontaneous "subaristate" variants occur sporadically through much of the range of *Pectis angustifolia* var. *angustifolia* and are particularly common in western Texas and northern Mexico. Within populations of var. *tenella*, individuals may be "subaristate" or even completely epappose. A similar condition sometimes occurs in var. *fastigiata*. In some areas of northern Mexico, individuals intermediate between var. *angustifolia* and var. *tenella* may have a subaristate pappus. Finally, in eastern Chihuahua and western Texas, "subaristate" races have developed apparently as a result of hybridization and introgression between var. *angustifolia* and *P. papposa* var. *grandis*.

REPRESENTATIVE SPECIMENS: **México.** CHIHUAHUA: near Chihuahua, *Pringle 648* (DS, F, GH, MICH, MO, NY, PH, RSA, US); 43 mi N of Villa Ahumada, *Stuessy 1114* (DS, ENCB, NY, TEX). DURANGO: 1.8 mi E of Nazareno, *K & M 8014* (OS). SONORA: Guadalupe Canyon, *Mearns & Merton 2034* (DS, NY, US).

United States. ARIZONA: Coconino Co.: 12 mi N of Cameron, *Cutler 3122* (DS, GH, MO, NY, US); Holbrook, *Zuck s.n.* (MO, NY, US). COLORADO: Fremont Co.: Royal Gorge, *Ownbey 1508* (DS, GH, MO, NY, UC); Otero Co.: 15 mi NE of La Junta, *Rollins 1873* (DS, MO, ND, NY, US). KANSAS: Ellis Co.: 12 mi SW of Hays, *Runyon & Bondy 288* (MO, PH, SMU); Trego Co.: without locality, *Hitchcock 294* (GH, KSC, MO, NMC, NY). NEBRASKA: Cherry Co.: Ft. Niobrara, *Bates s.n.* (CAS, GH); Deuel Co.: Big Springs Rd. at S. Platte River, *K 7633* (OS). NEW MEXICO: Dona Ana Co.: Organ Mts., *Wootton 426* (DS, GH, KSC, MO, ND-G, NMC, NY, POM, UC, US); Grant Co.: Bear Mts., *Metcalf 699* (ARIZ, GH, MO, NMC, NY, POM, UC, US); Lincoln Co.: Gray, *Skehan 45* (F, GH, KSC, MO, NMC, NY, POM, UC, US); Sierra Co.: Berendo Creek, Black Range, *Metcalf 1387* (CAS, F, GH, MO, NMC, NY, POM, UC, US). OKLAHOMA: Cimarron Co.: 2 mi S of Kenton, *Demaree 13381* (GH, MO, NY, PH, POM, SMU). TEXAS: Deaf Smith Co.: 1 mi S of Glenrio, *Waller 1526* (ASU, ENCB, SMU, TTC); Jeff Davis Co.: Ft. Davis, *Palmer 32151* (MO, PH). UTAH: San Juan Co.: Copper Canyon, *Cutler 3146* (GH, MO, NY, SMU). WYOMING: Goshen Co.: 12 mi below Ft. Laramie on N. Platte, *Simpson's Exped. s.n.* (MO)

- ✓ 5b. ***Pectis angustifolia* Torrey var. *tenella* (DC.) Keil, comb. nov.** BASIONYM: *Pectis tenella* DC., Prodr. 5: 99. 1836. TYPE:

Mexico. TAMAULIPAS: "prope Laraedo," *Berlandier 2009* (= 599) (Holotype, G-DC; photo of holotype, US!; microfiche, IDC 800. 787: III. 5!; isotypes, (2009) GH!, MO!, NY!, US!, (599) GH!, K!, MO!, PH!). Figure 6.

Bushy strong scented annuals. Stems 2–15 cm long. Leaves 1–4 cm long, not or scarcely flared at the base, evenly distributed on the stems. Peduncles 5–15 mm long, 1–4 bracteolate, not or scarcely concealed by the bases of the subtending leaves, the heads evidently slender-peduncled. Phyllaries 3–5 mm long, linear, widest near the middle, punctate with a solitary subterminal gland 0.2–0.5 mm long, and smaller submarginal glands. Ray corollas 3–5 mm long. Disc florets 10–18; corollas 2.5–3.5 mm long, regular or slightly bilabiate. Achenes 2.5–4 mm long. Pappus highly variable, coroniform and/or 1–7 setose or aristate, 1–3 mm long. Chromosome number: $n = 12$. Flowering June to January.

DISTRIBUTION: Eastern Chihuahua and southern Texas to Aguascalientes, San Luis Potosí and Veracruz. Also one station in northern New Mexico where probably adventive (Figure 7).

In most areas, *Pectis angustifolia* var. *tenella* is easily distinguished from var. *angustifolia*. Some individuals from Chihuahua, Durango, Aguascalientes and Zacatecas, however, possess the flared leaf bases or lemon scent of var. *angustifolia*, but in most other respects they resemble var. *tenella*. Because these individuals have the open branching pattern and bristly pappus of var. *tenella*, they are referred to this variety in the present treatment.

REPRESENTATIVE SPECIMENS: **México.** AGUASCALIENTES: near Aguascalientes, *Rose & Hay 7753* (GH, NY, US). CHIHUAHUA: 27 mi E of Jiménez, *Shreve 8867* (ARIZ, GH, MICH, US). COAHUILA: 27 mi S of Monclova, *K & M 7879* (OS); 25 mi SW of Sabinas, *Wynd & Muller 215* (ARIZ, GH, MO, ND, NY, US). DURANGO: between Yerbánis & Cuencamé, *Gentry 6941* (GH, MICH, US); 25 mi N of Bermejillo, *K & M 8192* (OS). NUEVO LEÓN: 25 km NE of Monterrey, *Dieterle 3678* (MICH). SAN LUIS POTOSÍ: San Luis Potosí, *Shaffner 325 [=235, 751]* (F, GH, MICH, NY, UC, US). TAMAULIPAS: Mier, *Gregg s.n.* (GH, MO, PH); vicinity of Victoria, *Palmer 431* (F, MO, NY, UC, US). VERACRUZ: Chinameca, *Peniche 27* (F, US). ZACATECAS: near San Raphael, *Shreve 9390* (ARIZ).

United States. NEW MEXICO: Rio Arriba Co.: Capulin Volcano, *Clark 4608* (UNM). TEXAS: McMullen Co.: 11¼ mi S of Tilden, *Cory 55339* (SMU, US); Webb Co.: without locality, *Tharp s.n.* (GH, MO, TEX, UC).

- 5c. ***Pectis angustifolia*** Torrey var. ***fastigiata*** (A. Gray) Keil, comb. nov. BASIONYM: *Pectis fastigiata* A. Gray, Mem. Am. Acad. 4: 62. 1849. TYPE: **United States**. TEXAS: Travis Co., Austin, *Wright s.n.* (Holotype, GH!; isotypes, GH!, NY!, US!).
Figure 6.

Pectis texana Cory, Rhodora 39: 421. 1937. TYPE: **United States**. TEXAS: Sutton Co., Ranch Experiment Station, *Cory 15382* (Holotype, GH!; isotype, TEX!).

Fibrous-rooted strong-scented perennials or sometimes annuals. Stems 5–15 cm long, sometimes woody at the base. Leaves 1–4 cm long, 1–2 mm wide, not or scarcely flared at the base, not crowded at the tips of the branches. Peduncles 3–30 mm long, 3–6 bracteolate. Phyllaries 2.5–4.5 mm long, narrowly oblanceolate, punctate with a conspicuous subterminal oil gland 0.5–1 mm long and 1 or 2 pairs of smaller submarginal glands. Ray corollas 4–6 mm long. Disc florets 8–21; corollas regular, 2.7–4 mm long. Achenes 2.5–3.5 mm long. Pappus 0–4 aristate, 0.5–1 (–2) mm long, also more-or-less coroniform. Chromosome number: $n = 12$. Flowering September to November.

DISTRIBUTION: Endemic to the Edwards Plateau area of central Texas, mostly on limestone soils (Figure 7).

Until now, the perennial nature of some plants of *Pectis angustifolia* var. *fastigiata* has not been noted. Some individuals of this taxon develop strongly lignified root crowns. Although both *P. fastigiata* and *P. texana* were both described as annuals, it is apparent from examination of additional specimens of these plants that the perennial condition prevails in several populations.

Correll and Johnston (1970) evidently were referring primarily to populations of var. *fastigiata* when they indicated that, in Texas, *Pectis angustifolia* occurs primarily on limestone soils. Both var. *angustifolia* and var. *tenella* occur commonly on a variety of substrates and are common on sandy soils. Only var. *fastigiata* is largely restricted to limestone soils.

In west-central Texas, on the western edge of the Edwards Plateau, several populations occur which are somewhat similar morphologically to *Pectis angustifolia* var. *tenella* (*Tracy 1852; Eggert s.n.*, 13 Jun 1900). These sites, however, are well outside the general range of this variety. The populations are situated within the range of var. *angustifolia* however, and not far outside the range

of var. *fastigiata*. Although none of these plants appear to have the perennial habit of var. *fastigiata*, some individuals possess the elongated subterminal oil glands of the phyllaries and the short aristate pappus of this variety as well as the flared leaf bases of var. *angustifolia*. Because of their geographical location and the evidence of morphological intermediacy, it seems best to treat these populations as intermediates between var. *angustifolia* and var. *fastigiata* rather than as disjunct populations of var. *tenella*.

REPRESENTATIVE SPECIMENS: **United States.** TEXAS: Bell Co.: 10 mi W of Belton, *Tharp s.n.* (GH, MO, NY, SMU, TEX, UC); Travis Co.: near Jollyville, *Tharp & Warnock 45-30* (ARIZ, DS, KSC, MICH, MO, NY, PH, RSA, SMU, TEX, TTC, US, WIS).

6. ***Pectis pringlei*** Fern., Proc. Am. Acad. **33**: 76. 1897. TYPE: **Mexico.** COAHUILA: Jimulco, *Pringle 125* (Holotype, GH!). Figure 8.

Strong-scented, tap-rooted annuals, branching from the base. Stems 2–25 cm long, erect or decumbent, pseudodichotomously branched, glabrous or puberulent. Leaves linear, 1–5 cm long, 1–2 mm broad, often revolute, basally ciliate with 2–4 pairs of bristles 1–2 mm long, glabrous or abaxially puberulent, marginally punctate with conspicuous elliptic to round oil glands 0.2–0.7 mm diameter. Peduncles 8–50 mm long, glabrous, with 1–4 scattered lanceolate bracteoles 1–2 mm long. Heads in forks of stems and axillary, becoming somewhat crowded in age. Phyllaries 8, linear to narrowly oblong, 4–6.5 mm long, 1–1.5 mm broad, obtuse, conspicuously hyaline-margined, with slender, corky, basally gibbous midribs, apically villous-ciliolate, otherwise glabrous, each punctate with a solitary subterminal oil gland and 1–4 pairs of smaller, elongated submarginal glands. Ray florets 8; corollas 5.5–6 mm long, with narrowly to broadly obovate glabrous ligules and sparsely glandular-puberulent tubes. Disc florets 10–21; corollas 3–4 mm long, regular, glandular-puberulent. Achenes 3–4.5 mm long, strigillose. Pappus 1–4 aristate; awns slender, antrorsely barbed, 2–4 mm long. Chromosome number: $n = 12$. Flowering July to November.

DISTRIBUTION: Southern Chihuahua, southern Coahuila and northern Durango at 1100 to 1800 meters elevation (Figure 5).

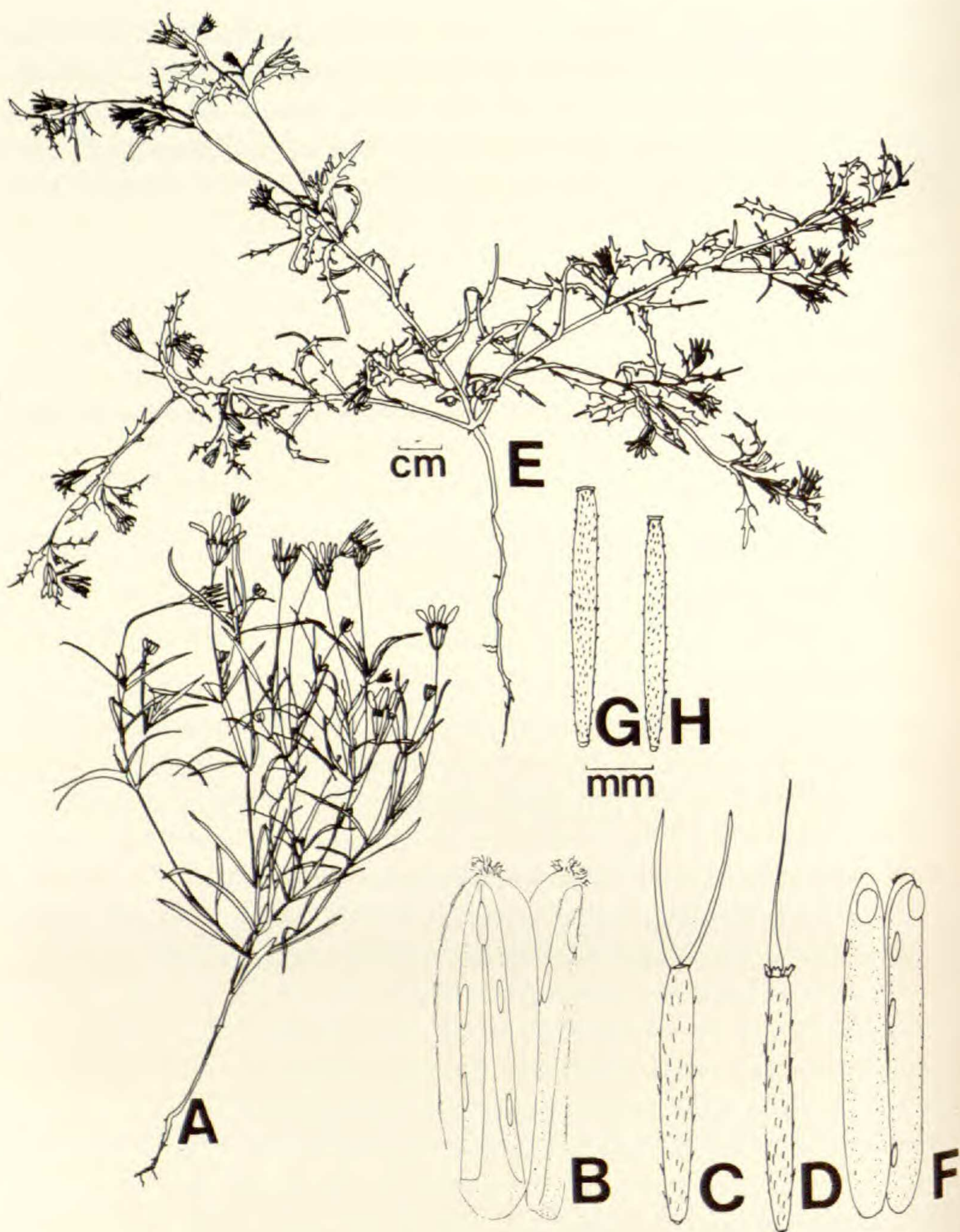


Figure 8. A-D, *Pectis pringlei* (Keil & McGill 7976, os); E-H, *Pectis incisifolia* (Keil & McGill 8105, os). A, E, habit; B, F, phyllaries, D, G, ray achenes; C, H, disc achenes.

Pectis pringlei is locally quite common on dry stony sites in the southern parts of the Chihuahuan Desert. Unlike the more widespread *P. angustifolia*, *P. pringlei* usually does not occupy sites on

the broad alluvial plains of this region. The latter species occurs on a variety of substrates including both igneous and sedimentary rocks.

Extreme forms of *Pectis pringlei* approach *P. papposa* var. *grandis* in habit and general aspect. The two taxa are easily distinguishable by their very different pappus structure and by the morphology of their phyllaries (Figures 4, 8). Some small, rather depauperate individuals of *P. pringlei*, on the other hand, resemble *P. angustifolia* var. *tenella*. The overall size and less congested appearance of the heads on *P. pringlei*, however, make distinguishing the two taxa rather easy. I have observed *P. pringlei* growing with both *P. papposa* var. *grandis* and with *P. angustifolia* var. *tenella* without any evidence of hybridization. The similarities observed with these taxa have probably resulted from localized selection rather than from hybridization and introgression.

REPRESENTATIVE SPECIMENS: **México**. CHIHUAHUA: 48 km S of Jiménez, *Cronquist & Fay 10759* (MICH, NY, OS); 19.5 mi S of Cd. Camargo, *K & M 8251* (OS). COAHUILA: jctn. of rd. to San Pedro & Rte. 40, *K & M 7988* (OS); 10.3 mi S of Rancho los Charcos, *K & M 8164* (OS); Jimulco, *Pringle 10091* (ARIZ, ASU, CAS, F, GH, LL, MICH, MO, NY, PH, SMU, UC, US). DURANGO: 17.5–22 mi SW of Nazareno, *K & M 8033, 8038, 8041* (OS); Huarichic, *Pennell 18603* (MICH, NY, PH).

7. ***Pectis incisifolia*** I. M. Johnst., Jour. Arnold Arb. **21**: 75. 1940. TYPE: **Mexico**. COAHUILA: just S of Laguna del Rey, *Johnston 7824* (Holotype, GH!; isotypes, CAS!, LL!, US!). Figure 8.

Strong-scented taprooted annuals. Stems decumbent to prostrate, dichotomously branched, 5–40 cm long, glabrous, stramineous to red-purple. Leaves linear to elliptic in outline, 1–4 cm long, 2–15 mm wide, irregularly pinnatifid with 2–4 pairs of remote, linear to triangular, acute, mucronate or bristle-tipped lobes 1–5 mm long and 1–2 mm wide, basally incised-ciliate with 2–4 pairs of slender bristle-tipped teeth 1–2 mm long, glabrous on both surfaces, marginally punctate with rounded oil glands 0.2–0.4 mm diameter. Peduncles 5–10 mm long, glabrous, with 1–3 linear-acute bracteoles to 2.5 mm long. Heads solitary in the forks of the stem, cylindric or campanulate. Phyllaries 8, narrowly linear, 5–6 mm long, 0.5–0.7 mm wide, strongly convex-keeled, basally gibbous, very narrowly scarious-margined, apically narrowed and subacutish, tipped with a tuft of minute hairs,

otherwise glabrous, each punctate with a solitary rounded subterminal oil gland ca 0.5 mm diameter and 1-4 pairs of slender, inconspicuous submarginal glands. Ray florets 8; corollas 4-6 mm long, with narrowly to broadly obovate ligules 2-4 mm long, glandular-puberulent on the tubes. Disc florets 12-15; corollas 3-4 mm long, regular, with teeth ca. 1 mm long, glandular-puberulent on the tube and throat. Achenes 3.5-5 mm long, glandular puberulent. Pappus absent. Chromosome number: $n = 12$. Flowering August to October.

DISTRIBUTION: Very local in southeastern Chihuahua and west-central Coahuila on sand dunes. Chihuahuan Desert endemic (Figure 5).

Pectis incisifolia appears to have a relict distribution. This species occurs only on the sand dunes which border certain playas or lagunas in the interior of the Chihuahuan Desert. *Pectis incisifolia* may have occupied a wider range before post-Pleistocene drought brought about the formation of the large playas. As noted by Johnston (1940), these areas are remarkable for the endemism of their floras.

Pectis incisifolia is a very distinctive species, well differentiated from all other species in sect. *Pectothrix* by its prostrate habit, pinnatifid leaves, and glandular, completely epappose achenes. This taxon does not appear to be closely related to any of the other species. Johnston (1940) suggested that *P. incisifolia* might be most closely related to *P. angustifolia*. Although I cannot rule out that possibility, I feel that a closer relative might be *P. papposa* because of similarities in the phyllary morphology. However, any relationship of *P. incisifolia* to either of these species is distant.

REPRESENTATIVE SPECIMENS: **México.** CHIHUAHUA: 9 km NE of Carillo toward Guimbalete, *Chiang, Wendt & Johnston* 9052 (LL); 36 mi ENE of Escalón along trail to Esmerelda, *Henrickson* 7766 (LL); 5 mi NE of Laguna Palomas, *Johnston* 7827 (GH); 5 mi E of Carillo, *Muller* 3317 (GH, LL, MICH, UC). COAHUILA: ½ mi E of Salinas on rd. crossing lake bed leading to La Chemica, *Bacon & Leverich* 1221 (TEX); S of Laguna del Rey, *K & M* 8101, 8102A, 8105, 8109, 8117, 8120 (OS); 6 mi N of Noria near Laguna del Rey, *Shreve* 8844 (ARIZ, US).

8. ***Pectis purpurea* Brandeg., Zoe 5: 225. 1905. TYPE: Mexico.**
SINALOA: Cofradia, *Brandegee s.n.* (Holotype, UC!; isotype, GH!).
Figure 9.

Plants annual. Stems 15–50 cm tall, one to several from the base, erect or ascending, branching above. Leaves 1.5–6 cm long, 1–9 mm wide, linear to narrowly elliptic or lanceolate, sometimes strongly revolute, punctate on the undersurface with circular or elliptic oil glands. Peduncles 4–13 cm long, with 4–10 bracteoles, these 1.5–3 mm long, scale-like, linear to lanceolate, hyaline except for the darkened midribs, marginally ciliate, often punctate with 1–2 glands. Heads solitary, terminal or axillary, campanulate. Phyllaries 8 or 9, 4–6.5 mm long, narrowly to broadly angular-obovate, obtuse to acute, with thin, hyaline margins and rounded backs, obtusely keeled below and basally gibbous, punctate with scattered linear to ovate oil glands, marginally ciliate, glabrous to puberulent on the back. Ray florets 8 or 9; corollas 7–11.5 mm long, yellow, often becoming whitish with purple veins when dry, glandular-puberulent below. Disc florets 20–50; corollas 3–5 mm long, yellow, bilabiate, with the narrow lobe ca. 4 times as long as the teeth on the broad lobe, glandular puberulent on the tube and throat. Achenes cylindrical to narrowly clavate, 2.3–4 mm long; ray achenes glabrous on the surface appressed against the subtending phyllaries, otherwise strigillose to villous; disc achenes evenly pubescent. Pappus of the rays biaristate or coroniform; the disc pappus coroniform or double. Chromosome number (from var. *sonorae* only): $n = 12$.

DISTRIBUTION: Southern Sonora to northern Nayarit. Locally common in thorn forest and semi-desert sites (Figure 10).

Pectis purpurea is apparently most closely related to *P. sinaloensis*. Unlike most species in sect. *Pectothrix*, both of these have glands scattered on the undersurface of the leaves or in submarginal rows on the undersurface. In addition, these species both have many-flowered heads, angular-obovate phyllaries and a biseriate disc pappus (except in one variety of *P. purpurea*). Although some forms of *P. purpurea* resemble *P. rusbyi* (Keil, 1974), the relationship between these two species is not as close as that between *P. purpurea* and *P. sinaloensis*.

8a. ***Pectis purpurea*** Brandeg., Zoe 5: 225. 1905. var. ***purpurea***.
Figure 9.

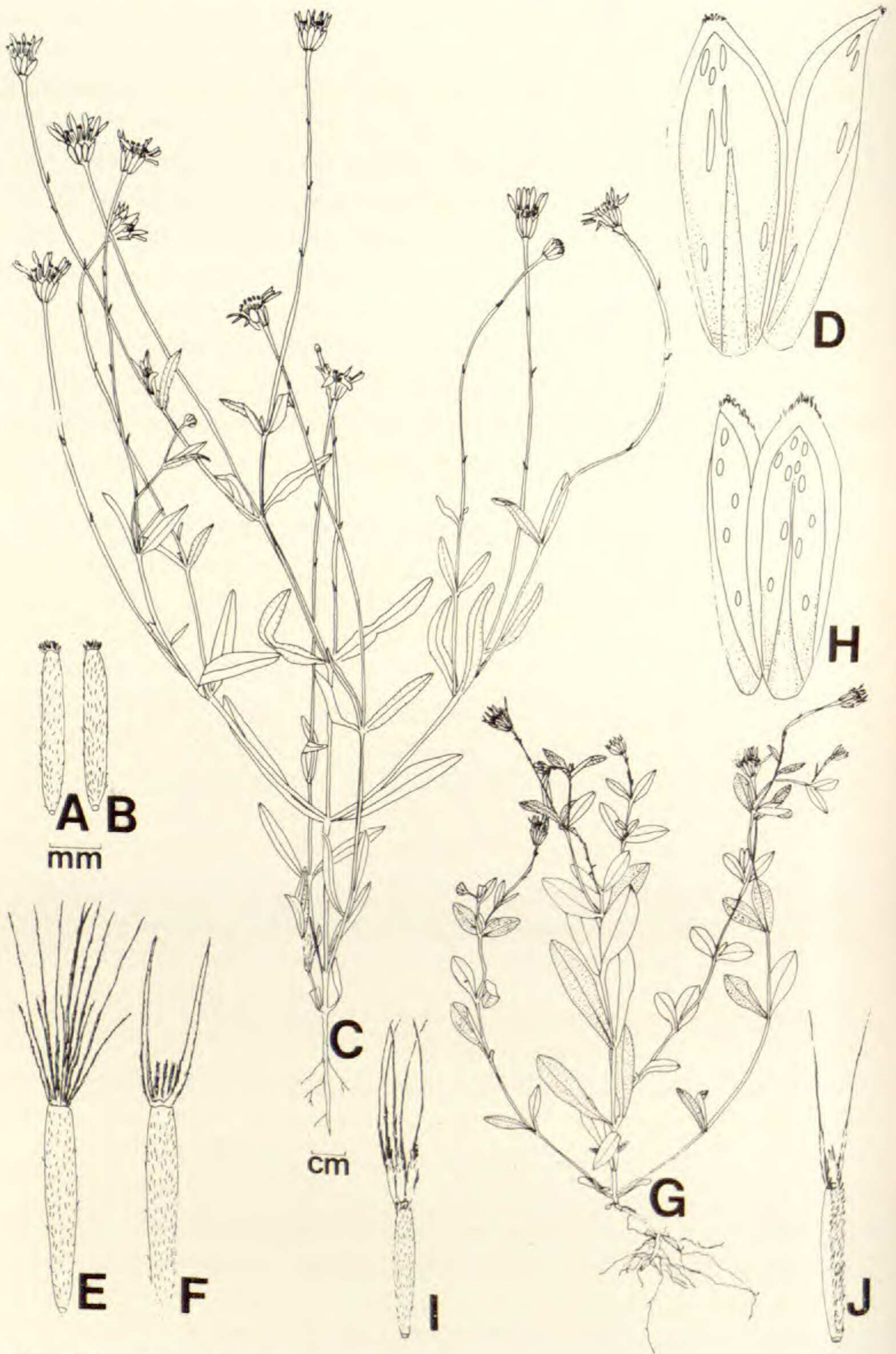


Figure 9. A-F, *Pectis purpurea*; A-B, var. *purpurea* (Gentry 5044, MO); C-F, var. *sonorae* (Keil & Canne 8737, os); G-J, *Pectis sinaloensis* (Keil & Canne 8810, os). A, E, I, disc achenes; B, F, J, ray achenes; C, G, habit; D, H, phyllaries.

Stems to 50 cm, minutely puberulent on the angles or glabrate. Leaves 1.5–4.5 cm long, 1–4 mm broad, acute to acuminate, mucronate, ciliate near the base with 1–3 pairs of bristles 1–3 mm long, glabrous, punctate with glands 0.4–0.7 mm in diameter scattered on the undersurface or in submarginal rows. Peduncles 6–11 cm long, glabrous, with 5–7 bracteoles 1–1.5 mm long. Phyllaries 4–4.8 mm long, 1–1.3 mm broad, glabrous, punctate with 5–10 glands in two vertical rows or scattered. Ray corollas 7–8 mm long, 1–1.3 mm broad. Disc corollas 20–40, 3–3.3 mm long. Ray achenes 2.3–3 mm long, strigillose; disc achenes 3.3–3.7 mm long, strigillose. Pappus of both ray and disc coroniform, 0.3 mm long. Chromosome number unknown. Flowering October to February.

DISTRIBUTION: Known only from the vicinity of the type locality in central Sinaloa at ca. 200 m elevation (Figure 10).

Pectis purpurea var. *purpurea* has been collected several times in and around Cofradia, Sinaloa since its initial discovery by T. S. Brandege. There is no evidence of intergradation of pappus structure between this variety and the other two varieties of *P. purpurea*, such as are found in some other species of sect. *Pectothrix*. The very local and isolated range of var. *purpurea* has apparently allowed this race to maintain its identity.

REPRESENTATIVE SPECIMENS: **Mexico.** SINALOA: Cofradia, *Gentry 5044* (ARIZ. MO); Cofradia, *Gentry 5496* (ARIZ. MO).

- 8b. ***Pectis purpurea* Brandeg. var. *sonorae* Keil, *Brittonia* 26: 35. 1974. TYPE: **Mexico.** SONORA: 1.9 mi NW of Vicam on Mexico Rte 15, ca. 66 mi SE of Guaymas, *Canne & Keil 8644* (Holotype, US!; isotypes, ARIZ!, ASU!, DES!, DS!, ENCB!, F!, GH!, MICH!, MO!, NY!, OS!, RSA!, SD!, SMU!, TEX!, UC!).**

Figure 9.

Stems to 50 cm, glabrous to densely puberulent. Leaves 1.5–6 cm long, 2.5–9 mm broad, obtuse to acute, mucronate, ciliate near the base with 1–3 pairs of bristles 1–2.4 mm long, glabrous to densely puberulent on the upper surfaces, glabrous or puberulent on the midribs below, punctate with glands 0.4–0.7 mm in diameter in submarginal rows on the undersurface. Peduncles 4–13 cm long, glabrous to densely puberulent, with 4–10 brac-

teoles ca. 2 mm long. Phyllaries 5–6.5 mm long, 1.8–3 mm wide, glabrous or puberulent, punctate with 4–12 scattered glands. Ray corollas 9–11.5 mm long, 2–3 mm wide. Disc florets 40–50, the corollas 4–5 mm long. Ray and disc achenes both 3–4 mm long, pilose or strigillose. Pappus of the rays biaristate, 2–3 mm long, with 1–4 short scales between the awns on the side adjacent to the subtending phyllary; pappus of the disc biseriate, the inner series of 5–10 stiff bristles 4–5 mm long, the outer series of 8–20 shorter, more slender bristles. Chromosome number: $n = 12$. Flowering August and September.

DISTRIBUTION: Southern Sonora and northern Sinaloa along the coastal plain (Figure 10).

Pectis purpurea var. *sonorae* is the most widespread and most variable of the three varieties of *P. purpurea*. The pubescence of the plants of var. *sonorae* ranges from subglabrous to densely puberulent within individual populations. The plants of this variety appear to be somewhat weedy and are often locally abundant. Some of the areas where this variety is found are heavily browsed, but *P. purpurea* does not appear to be touched. Perhaps the strongly scented foliage serves as a deterrent to browsing as the oils have a very disagreeable odor resembling that of stinkbugs (Pentatomidae).

REPRESENTATIVE SPECIMENS: see Keil (1974) for specimen citations for *Pectis purpurea* var. *sonorae*.

8c. ***Pectis purpurea* Brandeg. var. *lancifolia* (Greenm.) Keil, Brittonia 26: 36. 1974. TYPE: Mexico. NAYARIT: between Concepción and Acaponeta, Rose 1893 (Lectotype, GH!; isolectotypes, GH!, US!).**

Pectis sinaloensis Fern. var. *lancifolia* Greenm., Proc. Am. Acad. 40: 50. 1904.

Pectis lancifolia (Greenm.) Rydb., N. Am. Fl. 34: 203. 1916.

Stems to 40 cm, hirtellous on the angles. Leaves 2–3 cm long, 3–6 mm broad, acute, mucronate, ciliate along the margins with 4–6 pairs of bristles 2–3 mm long, densely short puberulent on the upper surfaces, hirtellous along the midribs beneath, punctate with glands ca. 0.25 mm diameter both submarginal and scattered on the undersurface. Peduncles 7–12 cm long,

short puberulent, with 4–8 bracteoles ca. 3 mm long. Phyllaries 5–5.5 mm long, 1.6–2 mm broad, glabrous or minutely puberulent, punctate with 4–6 scattered glands. Ray corollas 9–10 mm long, 2–3 mm wide. Disc florets ca. 40, the corollas 4.5–4.8 mm long. Ray and disc achenes both ca. 3.5 mm long, strigillose. Pappus of the rays biaristate, 3–4 mm long, with ca. 8 short scales between the awns on the side adjacent to the subtending phyllary; pappus of the disc biseriate, the inner series of 4–6 stiff bristles ca. 6 mm long, the outer series of 8–16 flattened, fimbriate pales to 2 mm long. Chromosome number unknown.

DISTRIBUTION: Known only from the type collection in northern Nayarit (Figure 10).

Pectis purpurea var. *lancifolia* is somewhat of an enigma. Known only from its type collection, this taxon is clearly a member of the *P. purpurea* complex. It is far removed geographically, however, from the nearest population of var. *sonorae*, which it most closely resembles. *Pectis purpurea* var. *lancifolia* may represent a relict population of a once more widespread *P. purpurea*, or conversely, may be a pioneer population. In either case, its present status is rather uncertain, because extensive modification of the habitat has occurred in the region where the type collection was made; in fact, this variety may well be extinct.

9. ***Pectis sinaloensis*** Fern., Proc. Am. Acad. 33: 69. 1897. TYPE: Mexico. SINALOA: Mazatlán, *Wright 1204* (Lectotype (here chosen), GH!; isolectotypes, F!, MO!, MSC!, US!). Figure 9.

Unscented, tap-rooted annuals, usually branching from the base. Stems 10–30 cm long, erect, or more commonly decumbent, branching above, short villous in lines or glabrate. Leaves linear-lanceolate, elliptic or oblanceolate, 1–5 cm long, 5–12 mm wide, obtuse to acutish, mucronate, basally ciliate with 2–6 pairs of bristles 1–3 mm long, glabrous or puberulent at the base, punctate on the undersurface with numerous scattered round oil glands. Peduncles 2–6 cm long, glabrous, with 4–6 scale-like bracteoles 1–2 mm long. Heads terminal and axillary, few. Phyllaries 8 (rarely 9 or 10), oblanceolate, 5 mm long, 1.5 mm wide, rounded

to subacute, broadly hyaline-margined, dorsally rounded, basally gibbous, apically short-ciliolate, otherwise glabrous, punctate with 6-12 scattered elliptical oil glands. Ray florets 8-10; corollas 5-7 mm long, with narrowly to broadly ovate glabrous ligules and sparsely glandular-puberulent tubes. Disc flowers 25-60; corollas 4-5 mm long, bilabiate, with the narrow lobe ca. 2 mm long, two or three times the length of the teeth on the broad lobe, sparsely glandular-puberulent. Achenes 2-3 mm long, those of the disc sparsely strigillose all over, those of the rays glabrous on the side adjacent to the subtending phyllary, otherwise densely strigillose. Pappus of the rays biaristate, 2-3 mm long, with a single fimbriate scale between the bristles on the side adjacent to the subtending phyllary. Pappus of the disc biseriate, of 5 stiff, antrorsely scabrid bristles 3-3.5 mm long, alternating with 5 fimbriate acute to bristle-tipped scales 1-2 mm long. Chromosome number: $n = 12$. Flowering September to January.

DISTRIBUTION: Known only from the coast of Sinaloa at a few meters elevation (Figure 10). This species is particularly common on the sea-cliffs at Mazatlán, the type locality.

At Altata, Sinaloa, *Pectis sinaloensis* has formed an extensive hybrid swarm with *Pectis papposa* var. *papposa*. T. S. Brandegees described *Pectis salina* from this population. The types of *P. salina* are intermediate between *P. sinaloensis* and *P. papposa*. The hybrids in this population are apparently fertile, and no detectable chromosomal irregularities were detected in any of the members of the population that I examined cytologically. Plants with varying degrees of intermediate characters are found in the population with extreme forms approaching both parents. Because of its origin, therefore, this hybrid population is to be known as *Pectis* × *salina* Brandegees, pro sp.

The plants in the *Pectis sinaloensis* population at Altata possess somewhat larger heads than those at Mazatlán. This feature may well be a result of instability introduced into the *P. sinaloensis* population by the long-term hybridization with *P. papposa*. If this is the case, there may not be any "pure" *P. sinaloensis* at Altata, only extremes of the hybrid swarm.

REPRESENTATIVE SPECIMENS: México. SINALOA: Mazatlán, K & C 8810 (os); La Neveria, N of Mazatlán, Mexia 1094 (CAS, F, GH, MICH, MO, NY, US).

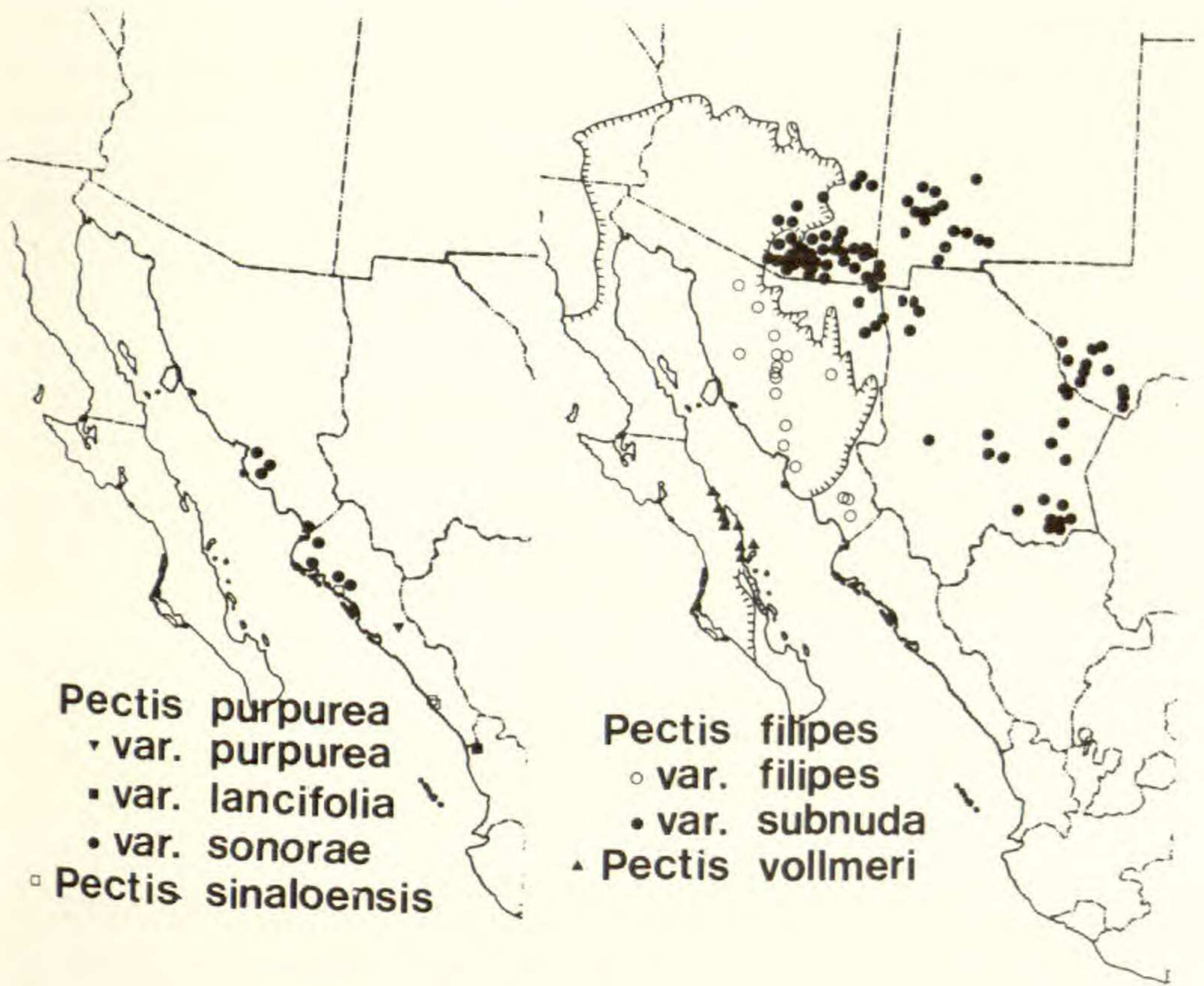


Figure 10. Geographical distribution of *Pectis purpurea*, *P. sinaloensis*, *P. filipes* and *P. vollmeri*. Half-barred line indicates Sonoran Desert boundary (redrawn from Shreve, 1942).

10. ***Pectis filipes*** Harv. & Gray in A. Gray, Mem. Am. Acad. 4: 62. 1849. TYPE: Mexico. "CALIFORNIA," (probably collected in Sonora near Guaymas or Hermosillo), *Coulter* 329 (Holotype, TCD!; isotypes, GH (fragment)!, K!). Figure 11.

Strong-scented, diffusely branched tap-rooted annuals. Stems 5–40 cm long, slender, pseudodichotomously branched, glabrous or puberulent. Leaves linear to narrowly elliptic, 1–6 cm long, 0.5–5.5 mm wide, often strongly revolute, basally ciliate with 1–4 pairs of bristles 1–2 mm long, otherwise entire, glabrous or puberulent, marginally punctate with rounded oil glands ca. 0.5 mm diameter. Peduncles filiform, 1–6.5 cm long, glabrous or puberulent, with 1–3, usually subterminal, lanceolate bracteoles ca. 1 mm long. Heads solitary in the forks of the stem, cylindrical to narrowly campanulate. Phyllaries 5, narrowly oblong

to oblong-obovate 3.5–6 mm high, ca. 1 mm broad, basally truncate and gibbous, apically ciliolate, obtuse to acute, hyaline margined, convex and slender-keeled, glabrous or puberulent, punctate with 0–2 small to large subterminal glands and 2–3 pairs of smaller, rounded to elongated submarginal glands. Ray florets 5; corollas 4–9 mm long, with narrowly to broadly obovate glabrous ligules and glandular-puberulent tubes. Disc florets 2–22; corollas 2.5–4 mm long, bilabiate, with the narrow lobe ca. twice the length of the teeth on the broad lobe, sparsely to densely glandular-puberulent. Achenes 2.5–4 mm long, shorter than the phyllaries, strigillose or short pilose with bifurcate hairs. Pappus 0–3 aristate, antrorsely barbed to nearly smooth, usually with an additional low crown ca. 0.2 mm high. Chromosome number: $n = 12$.

DISTRIBUTION: Southeastern Arizona and western Texas to southern Sonora and southern Chihuahua at elevations of 0–2000 meters (Figure 10). Within the broad altitudinal tolerances of *Pectis filipes*, two varieties may be distinguished. The typical variety has a primarily Sonoran Desert distribution, occurring mostly below 500 meters elevation. The variety *subnuda* grows mostly at higher elevations and barely reaches the fringes of the Sonoran Desert. This latter variety occurs mostly in the grassland and pine-oak-juniper zones and extends eastward into the Chihuahuan Desert.

Both varieties of *Pectis filipes* occasionally grow together with other species of sect. *Pectothrix* and sometimes form hybrids with these species. The variety *subnuda* locally hybridizes with *P. pringlei* in Chihuahua, with *P. papposa* var. *grandis* in New Mexico, and with *P. papposa* var. *papposa* in Arizona. The variety *filipes* hybridizes with both *P. papposa* var. *papposa* and with *P. rusbyi*. In one locality south of Hermosillo, Sonora, all three of these taxa were found to be involved in a single complex hybrid swarm.

Although interspecific hybridization involving *Pectis filipes* is relatively common, there is little evidence to suggest that the effects of the crossing are more than local. Throughout most of its range, *P. filipes* remains well differentiated from other species in the section. At the local populational level, some bizarre recombination types have been observed which combine the features of two or more species.

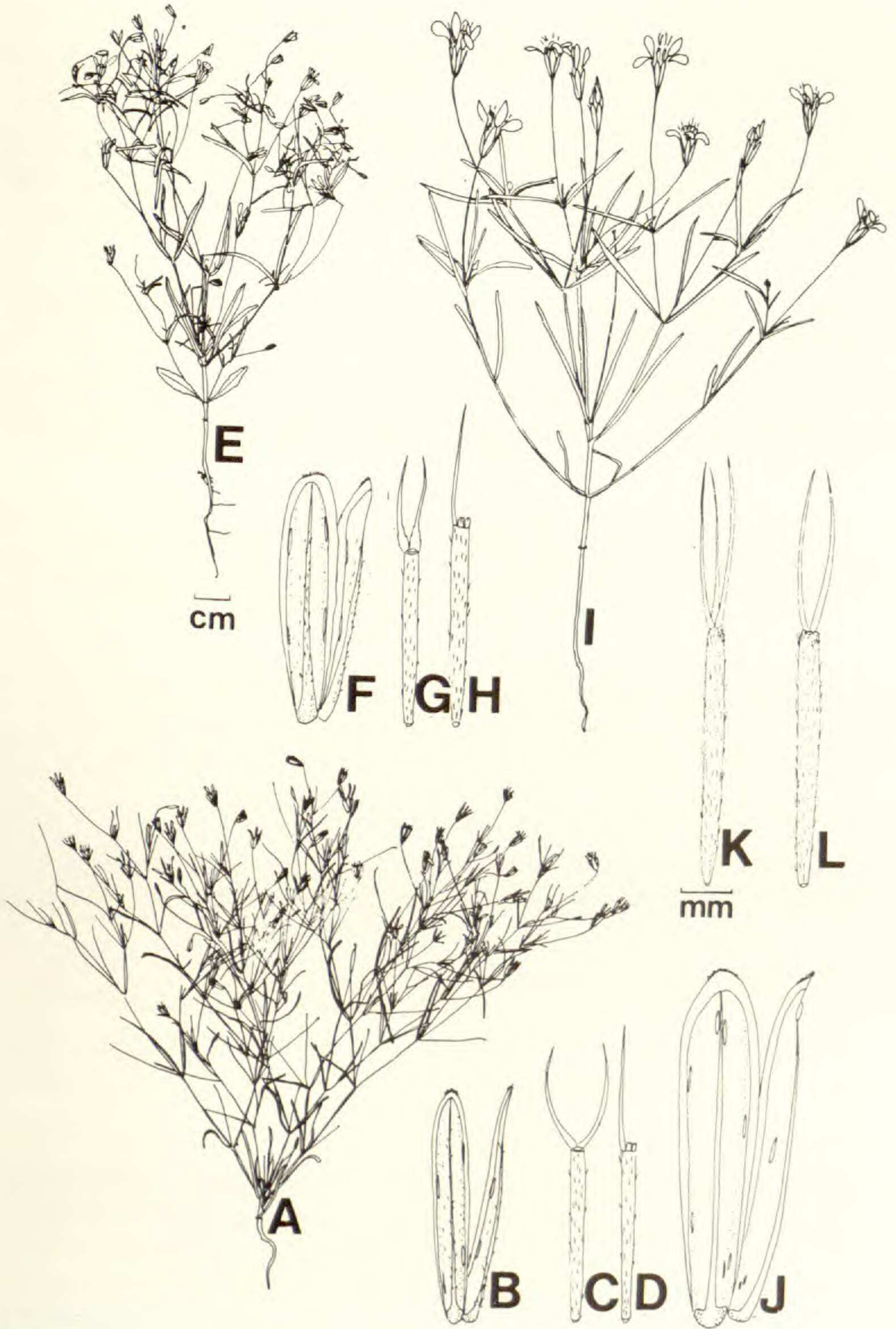


Figure 11. A-H, *Pectis filipes*; A-D, var. *filipes* (Keil & Canne 8659, os); E-H, var. *subnuda* (Keil & McGill, 8512, os); I-L, *Pectis vollmeri* (Carter & Moran 5250, CAS). A, E, I, habit; B, F, J, phyllaries; C, G, K, disc achenes; D, H, L, ray achenes.

- 10a. **Pectis filipes** Harv. & Gray in A. Gray, Mem. Am. Acad. 4: 62. 1849. var. **filipes**. Figure 11.

Herbage densely puberulent. Leaves linear, 1–3 cm long, 0.5–2.5 mm wide. Fascicles of several short narrow leaves usually developed in upper axils. Peduncles 1–2.5 (–3.5) cm long. Involucre cylindric; phyllaries acute, lacking subterminal oil glands. Disc florets 2–8; corollas 2.5–3.5 mm long. Oils of plants from southern Sonora lemon-scented, from other populations spicy-scented. Chromosome number: $n = 12$. Flowering August to October.

DISTRIBUTION: Central and southern Sonora, mostly below 500 meters elevation (Figure 10).

Coulter's type locality was listed as "California," a state where *Pectis filipes* is not known to occur. Rydberg (1916) suggested that this species was collected by Coulter in Arizona. Coulter's itinerary in Arizona (Coville, 1895), however, did not include any areas where *P. filipes* grows. Upon examination of the type of *P. filipes*, I found that it very closely resembles the Sonoran race of the species. Coulter is known to have collected at both Guaymas and Hermosillo, Sonora (Coville, 1895; McVaugh, 1943), and therefore it is likely that the type collection of *P. filipes* came from this region.

REPRESENTATIVE SPECIMENS: México. SONORA: 28 mi S of Hermosillo, K & C 8617 (OS); 11.8 mi E of jctn. w/Mexico 15 on rd. to Álamos, K & C 8665 (OS); 14 mi S of Divisaderos, Wiggins 7469 (ARIZ, DS, MO, TEX, US).

- 10b. **Pectis filipes** Harv. & Gray in A. Gray var. **subnuda** Fern., Proc. Am. Acad. 33: 76. 1897. TYPE: México. CHIHUAHUA: Janos, A. Schott s.n. (Lectotype (here chosen), GH!). Figure 11.

Herbage glabrous to moderately puberulent. Leaves linear to narrowly elliptic, 1–6 cm long, 1–5.5 mm wide. Peduncles (1–) 2–6.5 cm long. Involucres cylindric to campanulate; phyllaries obtuse to acute, with or without subterminal oil glands. Disc florets 7–22; corollas 3–4 mm long. Oils spicy-scented but not lemon-scented. Chromosome number: $n = 12$. Flowering July to November.

DISTRIBUTION: Southeastern Arizona and western Texas to northeastern Sonora and southern Chihuahua, mostly at 1000–3000 meters elevation (Figure 10).

The present treatment of *Pectis filipes* var. *subnuda* as a widespread eco-geographical race differs markedly from the much more restricted concept of Fernald (1897), who considered var. *subnuda* to be merely a minor morphological variant in the much more widespread species, *P. filipes*. As the epithet, *subnuda*, is available in the varietal rank and my concept of the upper elevation race of *P. filipes* includes the types of var. *subnuda* I have necessarily used this epithet for the redefined variety.

REPRESENTATIVE SPECIMENS: **México.** CHIHUAHUA: 10–14 mi W of Hidalgo del Parral, *Gentry 8257* (GH, MICH, US); 5.4 mi N of Janos, *K & M 8414* (OS); Mts. NW of Chihuahua, *LeSueur 1019* (CAS, F, GH, MO, TEX, UC). SONORA: Guadalupe Canyon, *Mearns & Merton 2048* (DS, NY, US); N of Horconcos, *Phillips 848* (ARIZ, MICH).

United States. ARIZONA: Cochise Co.: Chiricahua Mts., *Blumer 1708* (ARIZ, DS, F, GH, KSC, MO, NMC, NY, US); Bowie, *Jones 4227* (ARIZ, DS, F, MICH, MO, NMC, NY, PH, POM, UC, US); Greenlee Co.: Big Lue Range, *Gould & Haskell 4091* (ARIZ, CAS, DS, F, NY, UC); Pima Co.: Santa Rita Mts., *Pringle s.n.* (CAS, F, GH, MICH, MO, NY, PH, US). NEW MEXICO: Grant Co.: 18 mi NW of Silver City, *Metcalfe 685* (ARIZ, MO, ND-G, NMC, NY, POM, UC); Burro Mts., *Rusby 185* (F, MICH, MO, NY, PH, UC, US); Coppermine Creek, *Wright 1125* (GH, K, MO, NY, PH, TCD, UC, US); Sierra Co.: Black Range, *Metcalfe 1357* (CAS, F, GH, MO, NMC, NY, POM, UC). TEXAS: Brewster Co.: Big Bend Nat'l. Park, *Correll & Correll 35379* (ENCB, MICH, SD, TEX, US); 15.1 mi N of Castolon, *K & M 7797* (OS).

11. ***Pectis vollmeri*** Wiggins, Contr. Dudley Herb. 4: 27. 1950.

TYPE: **Mexico.** BAJA CALIFORNIA SUR: foot of Coyote Grade 20 mi S of Mulegé, *Wiggins 11407* (Holotype, DS!; isotypes, CAS!, DS!, GH!, UC!, US!). Figure 11.

Strong-scented, tap-rooted annuals. Stems 5–50 cm long, erect to decumbent, pseudodichotomously branched, glabrous, purplish. Leaves linear, 1–6 cm long, 1–2 mm broad, often revolute, basally ciliate with 2–3 pairs of bristles 1–2 mm long, rarely with 1–3 short basal lobes, otherwise entire, glabrous, marginally punctate with round to elliptic oil glands ca. 0.3 mm diameter. Peduncles 3–8 cm long, glabrous, with 2–3 scattered, linear acuminate glabrous bracteoles 1–2 mm long. Heads solitary in the forks of the stem. Phyllaries 5, narrowly obovate, 6–8 mm long, 1.5–2.5 mm broad, apically obtuse, ciliolate, basally truncate and

gibbous, hyaline-margined, convex on the back, round-keeled below, glabrous, punctate with 0-3 small, rounded subterminal oil glands, and 3-7 pairs of narrow scattered submarginal glands. Ray florets 5; corollas 6-10 mm long, with broadly ovate glabrous ligules and glandular-puberulent tubes. Disc florets 9-19; corollas 4-5 mm long, weakly bilabiate with the narrow lobe ca. twice as long as the teeth on the broad lobe, glandular-puberulent on the tube and throat. Achenes 4-6 mm long, cylindric, strigillose to short pilose. Pappus 2-6 aristate; awns stiff, spreading, 3-4 mm long, purplish, antrorsely scabrid toward the tips. Chromosome number unknown. Flowering September to November and again from February to April.

DISTRIBUTION: Endemic to a narrow strip along the eastern coast of Baja California at elevations of 0-500 meters (Figure 10).

Pectis vollmeri appears to be most closely related to *P. filipes*. Both species share the characteristics of slender, diffuse habit, five-rayed heads, and aristate pappus. *Pectis vollmeri*, however, is somewhat stouter and has larger heads and flowers. Wiggins (1950) suggested that *P. vollmeri* was closely related to *P. linifolia* L. of sect. *Pectidium*. Although both species do have similar pappus structure, the two taxa differ greatly in size of the florets, number of disc florets, placement and size of foliar oil glands, glandularization of the disc corollas and in overall habit. In my opinion, the relationship between *P. vollmeri* and *P. linifolia* is distant, and the similarities in pappus structure are the result of parallel evolution rather than of patristic relationship.

REPRESENTATIVE SPECIMENS: México. BAJA CALIFORNIA SUR: 40.6 mi S of Mulegé, Carter, Alexander & Kellogg 1988 (DS, GH, US); SW of Santa Rosalia, Carter & Kellogg 3082 (CAS, GH, MO, SD, US); Rancho Aguajito, Carter & Moran 5250 (CAS, SD, UC, US); Coyote Bay, Gentry 4068 (ARIZ, DS, GH, MO, UC, US); Arroyo de San José de Magdalena, Wiggins 11386 (DS, GH, UC, US).

DOUBTFUL AND EXCLUDED TAXA

Pectis aquatica S. Wats., Proc. Am. Acad. 23: 279. 1888. TYPE: México. CHIHUAHUA: at base of Sierra Madre (S of Cd. Guerrero), Pringle 1296 (Holotype, GH!; isotypes, F!, MO!). =***Hydropectis aquatica*** (S. Wats.) Rydb.

Pectis fasciculata Poir. in Lam. & Poir., Encycl. Method. Bot. 5: 120. 1804. TYPE: grown from seed of unknown origin (no type specimens located). This species is indeterminable.

Pectis multiradiata Sesse & Mocino, Fl. Mex. ed. 2. 190. 1894.
 TYPE: Mexico. SINALOA: prope Oppidum (no type specimens located). This species is indeterminable.

ACKNOWLEDGMENTS

This study is based in part upon a dissertation presented in partial fulfillment of the requirements for the Ph.D. degree at the Ohio State University. Field studies were supported by National Science Foundation Grant GB-30240. I wish to thank Dr. Tod F. Stuessy and Dr. Donald J. Pinkava for critically reviewing the manuscript. Thanks are also extended to Miss Judith M. Canne and Mr. Lyle A. McGill for their assistance during the field studies.

LITERATURE CITED

- BLAKE, S. F. 1945. Asteraceae described from Mexico and the southwestern United States by M. E. Jones, 1908-1935. *Contr. U. S. Natl. Herb.* **29**: 117-137.
- BRADLEY, C. E., & A. J. HAAGEN-SMIT. 1949. The essential oils of *Pectis papposa*. *Econ. Bot.* **3**: 407-412.
- CANDOLLE, A. P. DE. 1836. *Prodromus systematis naturis regni vegetabilis, sive enumeratio contracta ordinum generum, specierumque plantarum.* vol. 5. Treuttel & Würtz, Paris.
- CORRELL, D. S., & M. C. JOHNSTON. 1970. *Manual of the vascular plants of Texas.* Texas Research Foundation, Renner.
- CORY, V. L. 1937. Some new plants from Texas. *Rhodora* **39**: 417-423.
- COVILLE, F. V. 1895. The botanical explorations of Thomas Coulter in Mexico and California. *Bot. Gaz. (Crawfordsville)* **20**: 519-531.
- FERNALD, M. L. 1897. A systematic study of the United States and Mexican species of *Pectis*. *Proc. Am. Acad.* **33**: 57-86.
- GENTRY, H. S. 1942. Rio Mayo plants. Carnegie Institute of Washington Publ. 527.
- . 1946. Notes on the vegetation of Sierra Surotato in northern Sinaloa. *Bull. Torrey Bot. Club* **73**: 451-462.
- GRAY, A. 1849. *Plantae Fendlerianae Novi-Mexicanae.* *Mem. Am. Acad.* **4**: 1-116.
- . 1852. *Plantae Wrightianae Texano-Neo-Mexicanae.* I. *Smithsonian Contr. Knowl.* **3(5)**: 1-146.
- . 1884. Contributions to North American botany. *Proc. Am. Acad.* **19**: 1-96.
- KEARNEY, T. H., R. H. PEEBLES, & COLLABORATORS. 1942. Flowering plants and ferns of Arizona. U.S.D.A. Misc. Publ. 423.
- KEIL, D. J. 1974. New taxa in *Pectis* (Compositae: Pectidinae) from Mexico and the southwestern United States. *Brittonia* **26**: 30-36.
- LESSING, C. F. 1830. *De synanthereis herbarii regni Berolinensis.* *Dissertatio secunda.* *Nassauvieae.* *Linnaea* **5**: 1-236.
- . 1831. *De synanthereis.* *Dissertatio quarta.* *Linnaea* **6**: 624-721.

- MCVAUGH, R. 1943. The travels of Thomas Coulter, 1824-1827. *Jour. Wash. Acad. Sci.* **33**: 65-70.
1956. Edward Palmer: plant explorer of the American West. Univ. Oklahoma Press, Norman.
- POWELL, A. M., & B. L. TURNER. 1963. Chromosome numbers in the Compositae. VII. Additional species from the Southwestern United States and Mexico. *Madroño* **17**: 128-140.
- RYDBERG, P. A. 1916. (Carduales) *Carduaceae*. *Tageteae*, *Anthemidae*. *N. Am. Fl.* **34**: 181-288.
- SHREVE, F. 1942. The desert vegetation of North America. *Bot. Rev.* **8**: 195-246.
- STAFLEU, F. A., ed. 1972. International code of botanical nomenclature. *Regnum Veg.* 82.
- WIGGINS, I. L. 1950. Taxonomic notes on plants from the Sonoran desert. *Contr. Dudley Herb.* **4**: 15-31.

DEPARTMENT OF BOTANY
THE OHIO STATE UNIVERSITY
1735 NEIL AVENUE
COLUMBUS, OHIO 43210

Present address:

BIOLOGICAL SCIENCES DEPARTMENT
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CALIFORNIA 93407